VOLUME 23 JUNE, 1959 NUMBER 2

A Precognition Experiment Comparing Time Intervals of a Few Days and One Year ..... *Margaret Anderson* 81

Causality and Parapsychology ..... *C. J. Ducasse* 90

An Experimental Study Suggesting a Relationship Between Psychokinesis and Nuclear Conditions of Matter .. *H. Forwald* 97

A Test of Adding Extrasensorially Perceived Digits *Catherine S. Nash and Carroll B. Nash* 126

A Probabilistic Model for ESP ..... *N. T. Gridgeman* 130

Comments and Letters

Experimental Objectives of the Anderson-White Work with School Children *(Gardner Murphy) (Margaret Anderson)* 133

Some Comments Apropos of Pooling *(J. R. B. Whittlesey) (J. A. Greenwood)* 135

Current Thought and Parapsychology *(T. Dumont)* 137

Parapsychological Abstracts 140

Announcements by the Parapsychological Association 143

Glossary 145

ENTIFIC QUARTERLY DEALING WITH EXTRASENSORY PERCEPTION, THE PSYCHOKINETIC EFFECT, AND RELATED TOPICS

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The Journal *of* Parapsychology

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A PRECOGNITION EXPERIMENT COMPARING TIME INTERVALS OF A FEW DAYS AND ONE YEAR

By MARGARET ANDERSON[1]

ABSTRACT: An experiment was designed primarily to test the occurrence of precognition over a span of one year. The subject, who was in France, called 10 runs of ESP symbols per month for nine months. The targets were chosen at the Parapsychology Laboratory of Duke University after the subject had made her calls. The targets for five of the runs each month were selected as soon as the record sheets were received by mail at the laboratory. The other five runs were not checked until a year later. The overall results were significant. Those runs which were checked immediately gave scores that were only at the chance level, but the runs which were called a year in advance of checking were significant (the odds being 500 to one). The difference between the scores of the two time intervals was not significant.

Other trends in the results that are pointed out for their suggestive value are: (1) a general rise in scoring as the experiment continued; (2) a higher level of success during the second half of the month; and (3) a striking drop in the number of hits between the first and fifth segments of the run.—Ed.

INTRODUCTION

THE QUESTION of whether or not precognitive ESP is affected by the length of time interval which separates the subject from a target to be determined in the future has concerned many experimenters in laboratory tests for precognition. Of several studies directed to a comparison of results over different time spans, the longest reported is a time interval of one year (5).

[1] I wish to thank Miss Rose Hynes, who served as the subject in this experiment, and Miss Rhea White, who assisted in the tabulation of the data. I was supported in this work in part by a Ralph Drake Perry Fellowship.

Several experiments comparing precognition over shorter intervals have been published. Hutchinson (2), for example, obtained a significant positive score in a one-day test but an insignificant negative score in a 10-day test. Rhine (7) and Humphrey and Rhine (1), comparing the precognition scores over two days with those over a span of 10 days obtained in both researches a more significant effect with the longer period. Osis (6), in an experiment directed primarily to the general question of the occurrence of precognition, compared a one-day with a 33-day period. His subject gave a significantly negative total deviation in the experiment, the scoring being somewhat more significant for the one-month period.

In two independent precognition experiments, Dr. Carlos Marchesi in Zagreb, Jugoslavia, predicted in the first of his studies the order of the targets as they would be determined one day later in the Parapsychology Laboratory of Duke University (4); and, in the second study, he predicted the order of ESP cards one year in advance (5). While neither series was independently significant, the two combined gave a significant positive deviation. These experiments, conducted in 1946 and 1948 respectively, followed the standard Laboratory procedure employed at that time for precognition tests. This method has since been modified (3) to give more complete assurance regarding the exclusion of PK and clairvoyance in the determination of targets.

The experimental evidence encouraged me to design an experiment bearing directly on the problem of long-time precognition. The experiment reported here was planned primarily to test the occurrence of precognition over the time span of one year, utilizing the most advanced Laboratory methods and procedures.

A Sophomore student on the Duke Campus, Miss Rose Hynes, came to the Laboratory out of curiosity and asked to be tested for ESP in March, 1956. On her first test, which was five runs of clairvoyance, she scored 37 hits where a score of 25 is mean chance expectancy. From the time of this initial test until the end of the school semester of that year, she completed 30 GESP runs, 10 runs for clairvoyance, and 10 runs for precognition, doing five runs per session whenever she wished. The CR of her total score on all these trials (excluding her first test) was 2.90 ($P = .0003$). Thus

the previously published reports, the pilot experiments which the subject and I carried out in the Laboratory, and our mutual interest in precognition (which we spent hours discussing) all provided the motivational basis for the experiment reported here.

Miss Hynes was to take her Junior year of college in Paris, France, beginning in September, 1956. In the summer prior to her departure we planned this experiment in which we hoped to obtain evidence of precognition and to test further the hypothesis that a person can bridge a time interval of one year in a precognition test. The experiment was carried out over the nine-month period from September, 1956, through May, 1957, while the subject was a student in France.

Procedure

No cards were used in this experiment, and the entire project was carried out by mail. The subject took with her to Paris an ample supply of standard ESP record sheets with the understanding that she was to put down her calls for five runs of precognition on each sheet and complete two sheets per month, thus making a total of 90 runs for the nine-month experimental period. She was to make her monthly guesses in two sessions, considering each sheet of five runs as a session. She was free to complete the two sessions any time she chose during the month in question. That is, one session might immediately follow another or there might be a day or a week or a longer interval between sessions. She was free to choose whether to mail a sheet of five runs to me at the Parapsychology Laboratory in Durham, North Carolina, immediately after she completed the session or to wait until she had finished both monthly sessions and then return the two sheets together.

Since the subject had helped plan the experiments, she was aware that she was to guess the ESP symbols which sometime in the future would be randomly determined and entered on her record sheets in the card columns corresponding to the columns with her guesses. She was also aware that she would learn the results of five of her 10 runs each month but that it would be a year from each monthly session before she could know the scores of the remaining five runs and that it would be May, 1958, before the total results of the experiment could be made known to her.

The record sheets, each containing the subject's five runs, or 125 guesses, were mailed to me at the Laboratory. Immediately after each record sheet or pair of sheets arrived (usually about five days after they were mailed), Miss Rhea White, a member of the Laboratory staff, randomly determined which of the runs were to be immediately checked and which would be checked a year from the month in which the session was done.

In order to assure that this separation could not be subjectively influenced by herself, Miss White used a complicated but strictly prescribed method of finding an entry point into the Kendall and Smith random number table to get a sequence of numbers for dividing the runs into those to be checked immediately and those to be checked after one year. The method of entering the table involved throwing 10-sided dice to get four three-digit numbers, then carrying through a complicated calculation by machine to find the exact place to start reading the table—the same procedure used in getting the targets for a precognition experiment as described by Mangan (3). This procedure for separating the runs into two classes was used each time a batch of calls was received from the subject.

The details regarding the use of the digits from the random number table to achieve the desired separation of the runs into the two classes were as follows. If the two monthly sessions of five runs each were returned separately (as they were in October, December, March, and May), five two-digit numbers were read from the random number table on each occasion. For the first session of the month, the runs corresponding to the positions of the *two lowest* numbers among the first set of five were designated for immediate checking. When the runs for the second session of the month arrived later, the runs corresponding to the positions of the *three lowest* numbers in the set of five were chosen for immediate checking. When the two monthly sessions were returned together (as they were in September, November, January, February, and April), 10 two-digit numbers were put down in order from the random number table and the positions of the *five lowest* numbers among them were taken to indicate the five runs to be checked immediately.

On each occasion, after determining the runs to be checked immediately, Miss White went through the entire procedure again for

making another entry into the random number table to get the precognitive targets for the immediate-check runs. The digits from the random number table were then decoded into ESP target symbols which were written in the card columns of the appropriate runs.

The record sheets were independently checked by both Miss White and myself. The runs scores were then relayed to the subject along with encouragement and comments. On completion of the experiment in May, a third member of the Laboratory staff independently rechecked the 45 immediate-check runs.

The one-year check-up was carried out the first of each month, beginning with October, 1957, and extending through the first of June, 1958. The subject, now a college Senior and once again on the Duke Campus, was present for the checking of several of the monthly sessions. The same procedure for determining the precognition targets was followed as before: Miss White made an entry into the random number table and the digits from the table were decoded into ESP target symbols which were written in the card columns of the appropriate runs of the two sessions of the preceding month. Miss White and I independently checked the record sheets and the entire experiment was then rechecked by a third member of the Laboratory staff, beginning with the entry into the random number table.

Results

The subject scored 496 hits on the total of 90 runs, which gives a positive deviation of 46 above mean chance expectancy (see Table 1). The CR is 2.42, which has a significant probability of .014.

Table 1
General Results

Time Span	Runs	Hits	Dev.	Av. Run Score	CR	P
5 Days	45	230	+ 5	5.11		
1 Year	45	266	+41	5.91	3.06	.002
Total	90	496	+46	5.51	2.42	.014

The scores on the short-interval runs contributed a deviation of only +5, which is not significant; while the scores on the 45 runs checked

a year from the month in which they were completed yielded a positive deviation of 41 above mean chance expectancy. This gives a CR of 3.02, which has a probability of .002. These results show evidence of precognition and give an affirmative answer to the question asked at the outset. This subject apparently was able to bridge a time interval of one year in a precognition test.

There are some results of suggestive value which, while not specifically anticipated, will be mentioned for future reference. A comparison of the subject's scoring on the first four and a half months of the experiment and the last four and a half months, disregarding the time when the runs were checked, showed a positive deviation of 8 in the first half of the experiment as compared with a positive deviation of 38 in the second half, the latter being significant, with a P-value of .004 (see Table 2). The CR of the difference between the scoring of the two halves is suggestive ($P = .02$) though the chi-square resulting from an arrangement of the data in a two-by-two contingency table is at the chance level.

Table 2

RESULTS OF FIRST HALF OF THE EXPERIMENT COMPARED WITH LAST HALF REGARDLESS OF TIME CHECK

Time	Runs	Hits	Dev.	Av. Run Score	CR	P
First 4½ Months.....	45	233	+ 8	5.18		
Second 4½ Months....	45	263	+38	5.84	2.83	.004

$CR_{diff.}$ (First half-Second half) = 2.32
P = .02

The results of the subject's scoring on the first five runs of the month as compared with the last five runs of the month, regardless of the time check, show a positive deviation of 10 from mean chance expectancy on the runs of the first of the monthly sessions and a positive deviation of 36 on the runs of the second of the monthly sessions. The +36 deviation gives a CR of 2.68, which has a significant probability of .006 (see Table 3). The CR of the difference between the two halves is not significant.

The vertical distribution of hits in terms of the five segments of the run for the total experiment gives a CR of the difference between

Table 3

RESULTS OF FIRST FIVE RUNS OF THE MONTH COMPARED WITH SECOND FIVE RUNS REGARDLESS OF TIME CHECK

Runs Per Month	Total Runs	Hits	Dev.	Av. Run Score	CR	P
First Five.....	45	235	+10	5.22		
Second Five.....	45	261	+36	5.80	2.68	.006

the first and fifth segments of the run of 2.50 ($P = .01$) (see Figure 1). There is no significant difference between the first and the fifth segments of the runs for either of the time intervals considered separately.

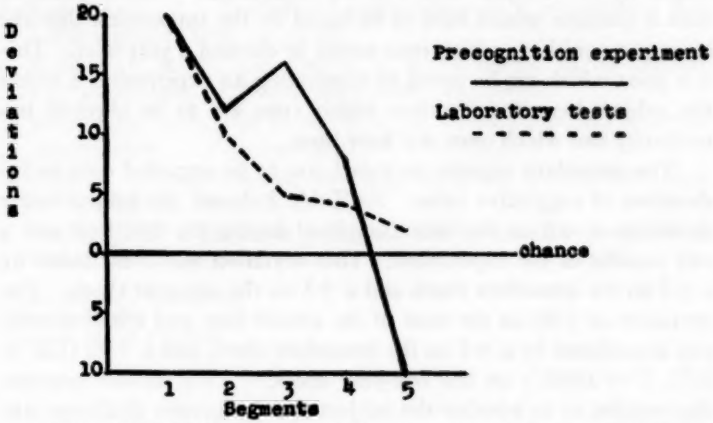

FIG. 1. Distribution of hits in the five segments of the run in the precognition experiment and in the preliminary tests carried out in the Laboratory.

The vertical distribution of hits in the five segments of the 50 runs the subject carried out in the Laboratory prior to the experiment reported here is of interest for comparative purposes. The CR of the difference between the first and fifth segments in this case is associated with the probability of .04 (see Figure 1).

As the results would indicate, there were more positive scoring sessions than negative ones. Six of the nine months each gave a positive deviation as compared with three which gave negative devia-

tions. Five of the nine monthly sessions checked immediately gave a positive deviation, three sessions were negative in deviation, and one session gave no deviation from chance expectancy. Of the nine monthly sessions checked a year from the date the session was done, six sessions gave a positive deviation, two gave negative deviations, and one session gave no deviation from chance.

Discussion

The results of this experiment support the precognition hypothesis. It may be worth noting that the one-year check gave a considerably larger deviation than the immediate check, although the difference is not significant. It is suggestive enough, however, to warrant the question as to whether the subject may have been more challenged by the one-year aspect of the experiment. Consideration of such a question would have to be based on the supposition that she knew precognitively which runs would be checked a year later. This is a point which can be tested by conducting an experiment in which the subject herself determines which runs are to be checked immediately and which ones at a later time.

The secondary aspects, as stated, are to be regarded only as indications of suggestive value. As Table 2 shows, the subject had a deviation of +8 on the runs completed during the first four and a half months of the experiment. This deviation was contributed by a +3 on the immediate check and a +5 on the one-year check. The deviation of +38 on the runs of the second four and a half months was contributed by a +2 on the immediate check and a +36 (CR = 3.75, P = .0002.) on the one-year check.[2] This further prompts the question as to whether the subject found a greater challenge and made a greater effort on the runs to be checked a year later.

While she was sustained by a deep philosophic interest in precognition, there was a marked fluctuation of interest noticeable from her letters, especially in the last four months of the experiment. During the first part of the testing program, she was encountering many new experiences. As she became acclimated to her new situa-

[2] These run scores of the year interval checking on the last four and a half months of the experiment were arranged in a one-by-two contingency table, divided according to above and below M.C.E. This yielded a chi-square of 6.54 (1 d.f.) which has a probability of .01. This result indicates that these runs showed a consistency of scoring above the chance average rather than only occasional runs with unusually high scores.

tion, her scoring began to improve. In December she wrote of her interest in a young Frenchman, and subsequent letters indicated her excitement and happiness in this developing romance. One cannot say that this factor explains the larger deviation on the last part of the experiment, but it seems a reasonable possibility. If this interpretation is correct, the findings suggest that the psychological state of the subject is an important factor in a precognition experiment as well as in other psi tests.

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CAUSALITY AND PARAPSYCHOLOGY

By C. J. Ducasse

It has been said that if a question is well formulated, it is already half answered. This is because no question is simply an empirical one unless it is unambiguous and is free both from internal inconsistencies and from arbitrary or false assumptions. It is obvious, for example, that the question: "When did you escape?" or: "Is he sober Sunday mornings?" tacitly makes about the person concerned an assumption which would be false about most of us.

1. *Semantical and empirical issues in parapsychological questions.* Some of the questions with which parapsychology deals are straightforward empirical ones and can be answered through observation and experiment carried on with scientific care. But certain others are unamenable to direct experimental settlement because some of the notions explicitly or tacitly employed in the formulation of them are too vague; or are inappropriate to the particular employment made of them; or are simply unsound. Such notions then generate puzzles which, because rooted in the mistaking of a semantical problem for an objective one, are gratuitous; and they also beget misapprehensions as to what is or is not entailed by certain of the experimentally ascertained facts.

2. *Some key concepts in the formulation of parapsychological problems.* Among the notions alluded to may be mentioned in particular that of causality and the allied ones of determinism, of mechanism, of purposiveness, of indeterminism, and of freedom; and the notions of materiality and of mentality. In what follows, the attempt is made to provide such clarification of these concepts as is likely to be useful to parapsychologists. This limited aim entails that whereas support for the statements that will be made, consideration of possible objections to them, and defense of them from these, would be appropriate if the statements were addressed to epistemologists, here on the contrary the statements will have to be made flatly, and the soundness and utility of them left to the parapsychological reader's appreciation.[1]

[1] Full discussion of those concepts can be found in the writer's *Nature, Mind, and Death.* La Salle, Illinois: Open Court Pub. Co., 1951.

3. *The causality relation.* The first of the analyses needed is that of the causality relation, which obviously enters into such parapsychological phenomena as telepathy, clairvoyance, psychokinesis, precognition and retrocognition.

Basically, causality is *the relation which obtains among the three terms of an experiment.* These are (*a*) a given limited state of affairs S; (*b*) an only change C occurring in it at a time T1; and (*c*) an only other change E in S occurring at the immediately sequent time T2. If a state of affairs S and two only changes C and E in it were so related, then the change C in S was by definition the *cause* of the change E in S, and the change E in S, the *effect* of C in S. (The state of affairs S and the change C in it may, but need not, have been set up and introduced by man.)

Causality is thus irreducibly *a three-term relation:* the circumstances, i.e., the state of affairs S, cannot be regarded as part of the cause since the latter consists of a *change* occurring in S. What is true is thus that the circumstances are an essential part, not of the cause, but *of the causality relation,* which is therefore triadic, not dyadic as too often tacitly assumed.

4. *Causation distinguished from causal law.* A *single* experiment, if it satisfies the requirements stated, is sufficient to prove that the first event caused the second under the circumstances that existed. Repetition of the experiment is called for in practice only to make more probable that no changes occurred that were additional to the changes C and E observed but that were overlooked.

De facto regular recurrence of E after recurrence of C in our past experience—which according to Hume is what constitutes the causality relation—is on the contrary neither sufficient nor necessary to establish causation of E by C. For on the one hand some sequences which are *de facto* constant nevertheless are admittedly not causal sequences; and on the other, a sequence of the particular type an experiment exhibits is a causal sequence irrespective of whether or not the state of affairs S and the two only changes C and E in it ever occurred before or ever occur again.

Causation is thus not ultimately or essentially causal *law.* Rather, if a given law is a law *of causation,* it is so only in virtue of its being a generalization that was inductively distilled out of particular se-

quences *each of which was a causal sequence in its own individual right* as described in Sec. 3.

5. *Causality neutral as regards material or mental events.* Attention may now be called to the important fact that nothing in the analysis of the causality relation either requires or forbids that the events C and E or the state of affairs S be material ones, or be mental ones, or be one material and another mental. The relation is wholly neutral as to this and leaves all these possibilities completely open.

More specifically, this means that causation of a material event by a mental event as in psychokinesis—or indeed as Thouless and Wiesner have pointed out, in ordinary voluntary movement—*involves no paradox at all,* but only raises the empirical question whether a person's brain tissue is the only material object in which his mental states can cause effects directly. Nor, similarly, is any paradox involved in causation of a mental event by a material one, as in clairvoyance or indeed in ordinary sensation; but only the again empirical question whether the events occurring in a person's brain tissue are the only material events capable of directly causing sensations or images in his mind.

6. *The question as to how causation can occur between matter and mind.* If, to the above, it should be objected that we do not understand *how* psycho-physical or physico-psychical causation takes place, then the reply would have to be that the question as to the "how" of causation never has any other sense than: "through what intermediary causal steps"; and hence that when a case in view is one of *proximate* not of mediated causation, then not the causation but the question "how?" concerning it, is what is paradoxical. For in such a case the question means:"Through what intermediary steps does C cause E without intermediary!"

7. *What is "material" and what is "mental?"* The term "the material world" denotes, *basically,* trees, rocks, water, air, animal bodies, etc., i.e., comprehensively, such things, events, processes or relations as are *perceptually public*; and, *derivatively,* its denotation includes also molecules, atoms, and subatomic particles; the events occurring among them; and the energy at work there. For all of these, although not themselves perceptually public, are *existentially*

implicit in the things and processes that are public. Thus, the sole but sufficient title to be classed likewise as "material," which those non-perceptible things and processes have, derives from the fact that they are ***intrinsic constituents*** of the perceptually public ones denominated "material."

The term "mental" (or "psychical") has similarly both a basic and a derivative denotation. *Basically,* it denotes feelings, moods, sensations, images, desires, impulses, and so on; i.e., comprehensively, occurrences and processes that are *directly observable introspectively* and not otherwise. And, *derivatively,* the term "mental" or "psychical" denotes also such things as latent or repressed memories, and unconscious wishes, fears, inferences, attitudes or impulses. These are not accessible to introspection at the time or perhaps at all, but—as in the case of the entities and processes of theoretical physics—their existence is *postulated* because it would account for various facts of consciousness that otherwise remain unexplained. The study of unconscious mental processes, however, is still in its infancy as compared with that of atomic and subatomic processes; and the postulations of "depth" psychology are therefore as yet much less definitely confirmed by resultance from them of powers of prediction and of control.

8. *Causality, determinism, and freedom.* In order to be in position to judge what bearing some empirical fact of parapsychology, such for instance as precognition, does or does not have on the problem of human freedom or so-called "free will," it is necessary to distinguish sharply between two senses of the word "determinism," and also between the objective and the merely subjective sense of the word "chance."

It can be shown, although space is lacking here for the demonstration, that, from the analysis of causality in Sec. 3., it follows that every event—whether material or mental and not excepting human volitions—is caused and has effects. In *this* sense of "determinism," determinism is a fact. But this determinism does not entail determinism in the sense of theoretically universal predictability. For predictability depends on similarity of the new case to cases observed in the past, and the similarity is never complete. Every individual fact is, to some extent however small, different in its character or its relations from any other fact. Moreover, as Heisenberg has shown,

some of the observations on which certain predictions would have to be based are inherently impossible because the attempt to make the observations alters the fact which was to be observed.[2]

Anyway, such freedom as man has—which always has limits—does not require indeterminism; for indeterminism means *chance in the objective sense,* i.e., in the sense of fortuitous, causeless occurrence; not chance in the merely subjective sense that, as in the case of the tossed coin, we are not in position to observe the causes which we would need to know in order to be able to predict. A free act is not at all the same thing as a causeless, motiveless, fortuitous act, supposing there were any such.

That human volitions, like all other occurrences, have causes, does *not* entail that they are unfree in the sense of compelled. For to be acting *under compulsion* means that the act one is caused to do is an act one *dislikes* to do; for instance, handing one's money to the man who threatens: "Your money or your life!" Whereas to be *acting freely* means that the act one is caused to do is an act one *likes* or at least does not dislike, to do; for instance, eating when one is hungry. In both cases equally, the act is *voluntary,* else it would not be an act at all but a passive experience: leaping is an act, but being tossed is not. That an act is voluntary, however, does not by itself answer the question whether it is free rather than compelled.

9. *Causality, purposiveness, and mechanism.* For discernment of what the facts of parapsychology do or do not entail concerning the personality of man, a clear conception is required also of the relation between mechanical and purposive causation.

Purposive causation is causation in the very same sense defined in Sec. 3; but is marked off from mechanical causation by the fact that, in purposive causation, the cause event consists of a craving, desire, or volition, and sometimes in addition of an idea of what would satisfy the craving; and sometimes further of belief that acting in a certain manner would cause occurrence of the state of affairs which would satisfy the craving or desire.

Causation is mechanical, on the other hand, if the immediate cause of what occurs does *not* consist of a craving, desire, or volition,

[2] A fuller discussion of the various conceptions of determinism can be found in Chap. 11 of the writer's *Nature, Mind, and Death;* and in his contribution to the New York University symposium, *Determinism and Freedom in the Age of Modern Science,* pp. 148 ff. N. Y. University Press, 1958.

whether or not with the possible additions just mentioned. It is then mechanical no matter whether the event caused be one in the inanimate world or be a human act; and if a human act, no matter whether it be a bodily or a psychological one. Some psychological processes, as well as some material ones, are mechanical.[3]

10. *The paradox of precognition.* Of the several modes of extrasensory perception, precognition is the one *prima facie* most paradoxical; for how can a nonexistent event—an event that has not yet occurred—cause anything? That an effect, for instance a precognitive dream, should occur earlier than what causes it is a contradiction *ex vi terminorum* and is therefore impossible.

Much ingenuity has been exercised—e.g., by J. W. Dunne, H. F. Saltmarsh, C. D. Broad— in attempts to reconcile this with the fact that precognition does occur; but clear success has not yet been achieved. The present writer, with benefit of those attempts, believes he perceives what the solution is, but an exposition of it would be too lengthy for introduction here. The most that can be done is therefore to indicate briefly the general lines along which the solution appears to lie.[4]

The basic fact is that no definition of the words "past," "present," and "future" is possible *in purely physical terms.* This means that a physical event, *considered solely in its relations to other physical events,* i.e., considered *in abstraction from perception of it and of them,* is neither past, present, nor future. Physical events as so considered have a temporal order, describable, in terms of the relation "between." This relation, however, is symmetrical, and this means that, in physical time, *two directions,* each the converse of the other, are distinguishable. One of them is marked by the fact that, in it, entropy never decreases; and the other by the fact that, in it, entropy never increases. But no meaning can be given in purely physical terms to a statement that one of these two directions is "real" and the other "unreal." In order to do this, *perception* of physical events is required; for in psychological time, perceptions and other mental events have a *unique* temporal direction, and any given psychological

[3] A fuller discussion of purposiveness and of mechanism by the writer is to appear in the journal *Philosophy and Phenomenological Research* under the title "Life, Telism, and Mechanism."

[4] A full account of it will be found in the shortly forthcoming volume on *The Philosophy of C. D. Broad,* in the Library of Living Philosophers series.

event is categorically either past, or past but still speciously present, or strictly present, or future. We commonly but erroneously assume that a physical event can be perceived only at the time when it is present (or past by but the time taken by it to stimulate our sensory apparatus). But the truth is on the contrary that temporal presentness is predicable at all of a physical event only in virtue of its being perceived; that is, *categorical presentness* (which no physical event *as such* has, any more than pastness or futureness) *is conferred upon a physical event by its being perceived, and as often as the event is perceived;*—perceived tonight, perhaps, in a dream; and the *same* event perceived perhaps again tomorrow through stimulation of the sense organs by it. The causal paradox—seeming violation of the principle that an as-yet-future event cannot without contradiction be supposed to cause anything before it itself occurs—thus evaporates because the physical event concerned is neither future nor past nor present *independently of perception of it or of some other physical event.* This leaves before us only the paranormal fact, which comes under the heading of clairvoyance, that a physical event can sometimes be perceived without stimulation of the sense organs by it, as well as, at another time, through stimulation of them.

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AN EXPERIMENTAL STUDY SUGGESTING A RELATIONSHIP BETWEEN PSYCHOKINESIS AND NUCLEAR CONDITIONS OF MATTER

By H. Forwald

ABSTRACT: Mr. Forwald continues the placement tests in which he tries to influence rolling cubes by PK to turn toward the right or the left side of the dice table. He is once more concerned with the measurement of the energy required to account for the amount of PK effect found in his results. In this report he studies the relation between the physical conditions of the experiment and the PK effect. Series were carried out with cubes having surfaces of different metals and of varying thicknesses. Out of these comparisons have emerged results which seem to the author to indicate some kind of relationship between the PK operation and the nuclear conditions of the surface material upon which the effect is demonstrated.

One theoretical explanation of this connection which was suggested was that PK might bring about a directionally-controlled emission of nuclear particles to produce the observed placement effect. However, a Geiger meter check of the cubes after they had been used in a successful PK placement test failed to produce any evidence in support of this suggestion. The experimenter therefore abandons this hypothesis and briefly considers other possible explanations of the observed facts. Regarding the possibility that the results might have been produced by psychological factors connected with his own strong motivation (as the subject) in having the results come out as they did, he argues that he did not have available the necessary information for so regulating the PK effect.

The detailed results of the paper will be of interest mainly to those readers who are qualified to deal with the technical questions it raises regarding chemistry and nuclear physics. For the general student of parapsychology, the fact of greatest interest may be that Mr. Forwald continued in these experiments to get consistently good PK placement results. With a single exception, all of the groupings of data (single or double series) yielded highly significant differences between the A and B sides as targets for the first throw of the set. The most recent series yielded the highest sustained rate of scoring Mr. Forwald has achieved so far.—Ed.

Introduction

The designation "psychokinesis" in parapsychology means "the direct influence exerted on a physical system by a subject without any known intermediate physical energy or instrumentation." Several experiments reported during recent years have led to the conclusion that psychokinesis occurs; for example, the extensive experiments conducted at the Department of Biophysics, University of Pittsburgh (7), and the supervised experiments of the author, car-

ried out in 1957 at the Parapsychology Laboratory of Duke University (8).

Most of the experiments in psychokinesis have been designed with the object of getting a confirmation of the effect on a *statistical* basis. Not only has confirmation repeatedly been achieved, but at the same time tendencies in the results have been found which show the same patterns as those observed in ESP experiments with cards. For instance, both ESP and PK results have exhibited the chronological decline effect within an experimental unit. This similarity and other reasons have led to the conception that the basic agency in extrasensory perception (ESP) is the same as that in psychokinesis (PK). This conception has led to a common designation "psi" for ESP and PK.

The statistical results in the PK research work have generally been achieved in experiments with dice in which the subject attempted to influence the frequency with which a die fell with a given face uppermost. But such a method is not well suited to the study of the energetics in the experimental situation. In order to study more closely the nature of the physical effect observed in PK we need to introduce some kind of *measurable forces* into the investigation. This has proved to be possible by the use of the so-called "placement" technique by means of which the deviation of a rolling cube from its natural direction of movement can be studied in relation to the subject's intention.

Procedure and Background

An experimental set-up used in applying the placement technique is shown graphically in Figure 1. It consists of a horizontal dice table provided with a co-ordinate system of ink lines drawn for each centimeter in the X- and Y-directions (length and width, respectively). An aggregate of cubes, usually six in number, can be released electrically from a V-shaped container arranged at some height above and outside the left end of the table as shown in Figure 1. The cubes roll down an incline, which curves out onto the table, and the aggregate reaches an entrance velocity u_o in the X-direction at the point $x = 0$, $y = 40$. From that point the cubes are subject to a rolling friction on the plane, causing them to slow down and come to rest.

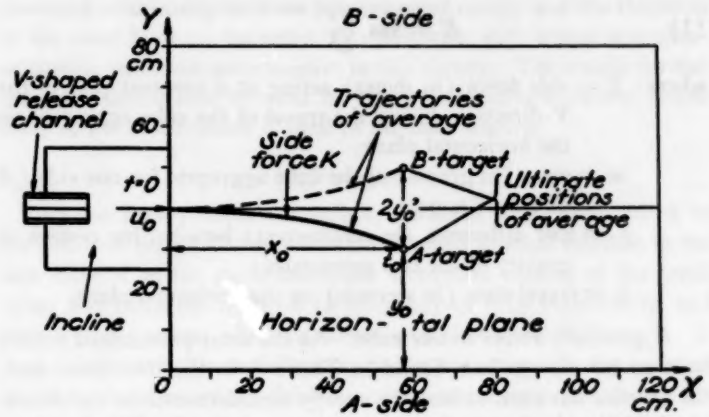


FIG. 1. Diagram of the apparatus and basic measurements of cube releases used in energy calculations.

Naturally there is a considerable scattering of the cubes in both directions, X and Y. But in two sufficiently long series with the same type of cube only small differences in the total *arithmetical mean values* of the ultimate cube positions in the two series would be expected by chance. If we divide one series into two parts of the same number of trials or releases, and we make mental attempts to obtain a deviation of the cube aggregate toward the A-side in Part 1 and toward the B-side in Part 2, then we can compare the averages of readings on the Y-axis in these two parts and decide, on a statistical basis, whether the difference between the averages is great enough to suggest an influence by the subject's mental processes upon the cubes.

The construction of the apparatus with its co-ordinate system, as well as the standard experimental procedure, have been extensively dealt with in previous papers (3, 4, 5). It may be mentioned here that the experimental unit is the *set,* comprising five releases of six cubes for the A-side as target, followed by five releases for the B-side as target. Five such sets constitute a *series.* The formula for the calculation of the side force K which has to be introduced in order to account for the deviation of the cube aggregate was developed in one of the former reports (3). The formula is as follows:

$$(1) \qquad K = 4m \frac{y'_o}{t_o^2}$$

where: K = side force (in dynes) acting at a constant rate in the Y-direction during the travel of the cube aggregate on the horizontal plane;
m = mass (in grams) of the cube aggregate for one side (A or B) as target;
y'_o = half difference (in centimeters) between the centers of gravity of the two aggregates;
t_o = travel time (in seconds) on the horizontal plane.

K generally refers to *one* cube. As the most pronounced results have so far always been found in Throw 1 in the five-throw unit, the practice has been to base the energy measurements on the results obtained in this throw. The running time t_o is computed from the x-readings, assuming a constant entrance velocity $u_o = 186$ cm./sec. for all cube types. This velocity was calculated on the basis of measurements of t_o with wooden cubes. Since the cubes fall through air after they have been released and thus are subject to the acceleration due to gravity, it is plausible to assume that there can not be substantial differences in u_o for the various cube types.

The research with the apparatus shown in Figure 1 was started with wooden cubes (3). An experiment with bakelite cubes followed in which attention was directed toward a possible influence of the cube *roughness* on the side force K (4). The data gave some support to the opinion that the effects were stronger with a rough cube surface than with a smooth one. The results obtained in the following experiments (5), however, made it necessary to change this opinion. Support was found in the sequel for the hypothesis that the *material* in the cube surface had an influence on the dynamical effects. This led to experiments with wooden cubes with an aluminum coating. It was found that the side force K increased with the thickness of the metal coating, and that it reached a maximum when the cube was of aluminum all through.

This line of research was followed up in the experiments dealt with in the present report. New materials were introduced in the cube coating, and the thickness of the coating was varied. Further series with an aluminum coating led to a theory suggesting an *ex-*

ponential relationship between the measured energy and the thickness of the metal layer on the cubes. Experiments with copper and silver as coating materials gave support to this theory. The results further indicate relationships between the energy and certain *nuclear conditions* of the metal which is used in the cube coating.

Results

As has been pointed out before, the most important finding in the previous report (5) was that there was a gradual increase in the side force K as the thickness of the aluminum coating of the beech cubes was increased from 8μ (8 microns) to 150μ respectively, and that K was greatest when the cubes were aluminum all through. It was found advisable to follow up in the new research the question about the influence of the thickness of the metal layer.

In the following paragraphs a chronological survey is given of how the work proceeded. It may be mentioned that all data refer to Throw 1 in the five-throw unit. Thus all K-values are based on the traveling distance x_o computed as the average of the x-readings in Throw 1.

In this report we have further introduced, as a *measure* of comparison more suitable than K, the *energy* E in ergs, considered as the product of the constant side force K and the deviation y'_o. A certain reduction of the energy has been made in some of the cases when the 16 mm. beech cubes were provided with a metal coating, because it seemed to be more appropriate for a study of the energetics to consider the energy *per unit of the cube surface.* When provided with a metal coating the cube surface was in some cases appreciably greater than that of a 16 mm. cube, and this resulted in a corresponding reduction of the energy calculated on the basis of the measured data. The energy figures contained in the remainder of this report are expressed in terms of a cube with 16 mm. sides.

In the series previously reported, these results were obtained:

Series	Material	y'_o (cm.)	K (dynes)	E (ergs)
S33+S34	beech	3.29	218	718
S35+S36	beech + 8μ alum.	4.65	259	1204
S37+S38	beech + 150μ alum.	5.60	404	2220

The new research was started with Series S43+S44, using beech cubes with 665μ aluminum. The results are: $y'_e = 4.77$ cm., $K = 752$ dynes, and $E = 3310$ ergs. Thus a further increase in the energy was obtained.

Table 1 gives the placement results for these series with the different cube materials, and Table 2 gives the basic data, from which the energy measurements were made, for Throw 1 in the five-throw unit.

Table 1

PK Placement Results with Different Cube Materials

Series	Cube Materials	Throw 1			All Throws
		$B-A$ Diff. in cm.	t_d	P	$B-A$ Diff. in cm.
S43+S44	beech + 665μ Al	+ 9.54	4.23	.000027	+2.03
S45	Al, oxided surf.	+ 3.56	1.25	.21	+1.25
S46+S47	Al, cleaned surf.	+ 8.20	4.19	.000032	+2.03
S48+S49	beech + 150μ Cu	+12.22	4.39	.000013	+4.01
S50+S51	beech + 300μ Cu	+10.35	3.73	.0002	+1.59
S52+S53	beech + 120μ Ag	+12.53	5.46	abt. 10^{-7}	+3.46
S54+S55	beech + 240μ Ag	+12.29	4.58	.000005	+4.27
S56+S57	beech + 600μ Cu	+ 9.78	3.07	.0021	+2.83
S58+S59	beech + 360μ Al	+ 9.48	3.72	.00021	+2.62
S60	beech + 515μ Pb, ox.	+10.13	3.39	.0007	+3.09
S61	beech + 515μ Pb, cl.	+14.37	4.22	.000028	+3.19
S62+S63	beech + 480μ Ag	+11.54	4.44	.00001	+2.51
S64+S65	Zn, 700μ, hollow	+ 8.93	4.16	.000037	+1.35
S66+S67	beech + 700μ Cd	+ 8.70	3.83	.00014	+2.41
S68+S69	beech + 700μ Bi	+17.28	9.53	abt. 10^{-18}	+5.80
S70	beech + 515μ Pb, cl.	+16.40	4.43	.000011	+7.11
S71	beech + 350μ Cd	+11.50	3.70	.00022	+1.48
S61+S70	beech + 515μ Pb, cl.	+15.38	6.12	abt. 10^{-9}	+5.15
S72+S73	$(CH_3)_4N_4$	+17.13	5.14	abt. 10^{-6}	+4.16

In Throw 1 in the five-throw unit one single series includes 30 trials for each target, *A* or *B*, and one double series 60 trials per target.

The plus-sign for a $B-A$ difference indicates that the deviation is in the specified direction.

Due to the circumstance that conclusions are based only on the Throw 1 results, no statistical evaluation has been made in the case of the results of the total series.

At this point of the investigation it was questioned whether any relationship could be found between the energy E and the thickness z of the metal layer. In this connection it was convenient to consider the equation:

$$E = E_m(1 - e^{-az}) \tag{2}$$

where E_m and a are constants. The exponential relationship expressed by this equation is often found in physical processes, as for

Table 2

BASIC DATA AND ENERGY MEASUREMENTS FOR THROW 1 IN THE FIVE-THROW UNIT CALCULATED ON THE BASIS OF ONE CUBE

Cube Material	Total Weight of Cube m (grams)	Travel Distance x_0 (cm.)	Deviation y'_0 (cm.)	Side Force K (dynes)	Energy E (ergs)
Beech, uncoated S33+S34	2.6	36.85	3.29	218	718
Beech with aluminum coating					
8μ, S35+S36	2.633	40.49	4.65	259	1204
150μ, S37+S38	3.23	39.33	5.60	404	2220
360μ, S58+S59	4.85	32.38	4.74	753	3410
665μ, S43+S44	5.6	35.09	4.77	752	3310
Aluminum					
190μ paper S39+S40	10.7	45.51	4.74	847	3910
uncoated, oxided S45	10.3	35.70	1.78	494	880
uncoated, cleaned S46+S47	10.3	41.10	4.10	868	3550
Beech with copper coating					
150μ, S48+S49	4.75	34.38	6.11	847	5090
300μ, S50+S51	7.5	29.80	5.18	1510	7560
600μ, S56+S57	12.0	33.93	4.89	1770	8060
Beech with silver coating					
120μ, S52+S53	5.3	28.75	6.27	1380	8540
240μ, S54+S55	7.5	28.63	6.15	1940	11550
480μ, S62+S63	11.3	29.10	5.77	2660	14500
Beech with 515μ lead coating					
oxided surface S60	12.6	26.82	5.07	3060	14600
cleaned surface S61	12.6	34.77	7.18	2590	17500
cleaned surface S61+S70	12.6	35.33	7.69	2680	19350
Zinc 700μ, hollow S64+S65	8.2	32.03	4.47	1235	5510
Beech with cadmium coating					
350μ, S71	7.25	35.47	5.75	1150	6600
700μ, S66+S67	12.7	33.05	4.35	1740	7600
Beech with 700μ bismuth coating S68+S69	14.4	40.31	8.64	2630	22700
Hexamethylenetetramine, $(CH_2)_6N_4$ S72+S73	5.7	46.10	8.57	798	6850

instance in the transmission of light through a transparent body. If we consider the metal cover on the cube as an absorber of incoming radiant energy, and E_m is the amount of energy which can be absorbed during a certain time interval by the material in question at $z = \infty$, then the equation gives the energy E which can be absorbed during the same interval by a layer of thickness z. The symbol a then is an absorption coefficient which depends on the material in the layer, and to a certain degree on the wave length of the radiation.

This is merely an example to illustrate the use of the formula. Such a process of absorption can scarcely be assumed under the ac-

tual conditions. However, it is useful to consider this formula in the preliminary stage of the investigation. An extensive treatment of the question will be presented in the Discussion.

After having finished Series S43+S44 the energies E found with 150μ and 665μ aluminum cover were introduced in the formula in order to find the corresponding value of E_m. This was discovered to be about 3400 ergs. If the relationship expressed by the formula was right, there was reason to believe that this was approximately the amount of energy which would be arrived at in a series with pure aluminum cubes, because the effective z of such cubes is several times greater than the cover of 665μ thickness, which had been associated with an energy as high as 3310 ergs.

As x-readings had not been taken in the previous series S28+S29 with pure aluminum cubes, it was necessary to repeat the experiments with these cubes in order to get suitable data for testing the theory.

The aluminum cubes had been used earlier in Series S39+S40 where they were provided with a 190μ paper coating glued to the surface. The paper was removed and Series S45 was carried out with these cubes. The results, however, were considerably weaker than those obtained in the previous series S28+S29, giving for E a value of but 880 ergs. A surface effect was suspected, because it was obvious from inspection of the cubes that there had been a chemical reaction between the glue and the metal.

After a thorough cleaning of the cube surface, Series S46 and S47 were carried out. They gave the results: $y'_o = 4.10$ cm., $K =$ 868 dynes, and $E = 3550$ ergs. This value differs from the calculated E_m (3400 ergs) by only 4.5 percent, and thus it apparently supports the theory that there is an exponential relationship between E and z.

The value of 1204 ergs in Series S35+S36 with 8μ aluminum coating is greater than that required by the theory. It might be supposed, however, that by employing this extremely thin metal layer an additional effect was caused by the material beneath the layer (glue and wood).

The situation after Series S46+S47 had been finished was that there seemed to be a lawful relationship between E and z. Such a lawfulness (the exponential curve) implies that PK involves atomic

or subatomic processes. From this the inference could be drawn that the ***kind*** of metal used in the cube coating would have an influence on the amount of energy E calculated as necessary to account for a result arrived at in a series.

The selection of a metal for use in continued experiments was guided by the assumption that the energy processes involved were in some way linked up with the conditions in the electron shells. It was assumed that a chemical element having a considerably greater number of valence electrons than aluminum would be useful. Copper was chosen. It has 10 valence electrons in the M-shell (and one in the N-shell), whereas aluminum has three valence electrons in the M-shell.

In Series S48+S49 beech cubes with a copper layer of 150μ thickness were used. The series gave the values: $y'_o = 6.11$ cm., $K = 847$ dynes, and $E = 5090$ ergs. This energy is 2.3 times the value found with 150μ aluminum cover (2220 ergs). The search for a relationship of some kind between these energies and the conditions concerning the valence electrons did not lead to any conclusions. It was decided, however, to make a series with 300μ copper too, in order to investigate whether an exponential relationship between E and z could be traced with this material as it had been with aluminum.

Series S50+S51 with 300μ copper gave the values: $y'_o = 5.18$ cm., $K = 1510$ dynes, and $E = 7560$ ergs. The energies with copper, 5090 ergs with 150μ, and 7560 ergs with 300μ thus gave support to the exponential relationship theory.

In order to get a more lucid picture of the conditions, a diagram (Figure 2) was prepared in which the energy E is represented as a function of the thickness z of the metal cover. Using the energies measured with 150μ aluminum coating and with pure aluminum cubes, an exponential curve according to Equation 2 was calculated for this material. It is shown as Curve 1 in Figure 2.

Since the investigation concerning a relationship between the energies and the valence electron conditions had not been productive, the question was raised whether any connection could be found between the measured energies and the *nuclear* conditions.

The measured energy with copper 150μ had given a value which is 2.3 times as high as that found with aluminum of the same thickness. This is approximately the ratio between the atomic weights

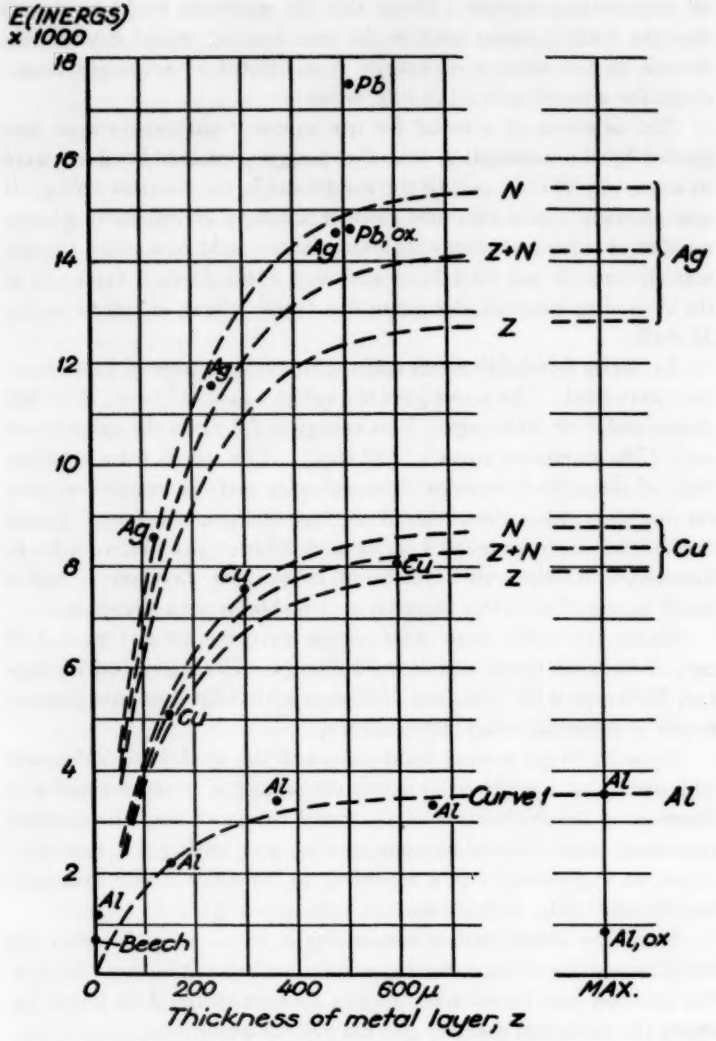


FIG. 2. Energy values for silver, copper, and aluminum in relation to thickness of cube coating and proton (Z) and neutron (N) ratios. These are exponential curves which take the values measured with aluminum as a base.

of copper (Cu) and aluminum (Al). These atomic weights are 63.54 and 26.98, respectively, giving a ratio of 2.355. The ratio between the *specific* weights of the two metals is about 3.3 and thus does not suggest a connection between the measured energies and *mechanical* properties of the materials.

As the atomic weight is almost entirely connected with the number of nucleons in the nucleus there was reason to explore the relationships between the energies and the number of protons (Z) and neutrons (N) in the nucleus.

The chemical element aluminum comprises only one stable isotope, Al 27, with $Z = 13$ and $N = 14$, whereas copper is composed of two stable isotopes, Cu 63 with $Z = 29$ and $N = 34$, and Cu 65 with $N = 36$, entering with 69 and 31 percent, respectively, in the metal. The average of N for copper thus is about 34.6. (It may be mentioned that when selecting the metal foils for the cube cover I have tried to get the materials as pure as possible. The metals actually used do not show any substantial differences from the pure chemical elements.)

In order to get a picture of how the energies measured with 150μ and 300μ Cu were compared with the energies obtained with aluminum, the curves are shown in Figure 2 for copper on the basis of a nuclear proportionality theory. That is to say, the energies according to Curve 1 for aluminum have been multiplied by the Z-, N-, and $Z+N$-ratios, copper/aluminum, giving the curves marked by Z, N, and $Z+N$. These ratios have on the basis of the nuclear data been calculated as 2.23, 2.47, and 2.36 respectively. (See Table 3.) $Z+N$, the so-called mass number, is very nearly equal to the atomic weight. Due to the proportionality existing between the different curves, they are all exponential, and essentially in accordance with Equation 2, because the basic curve for aluminum is exponential. In this graphical system the energies for 150μ and 300μ Cu are so situated that they may indicate an exponential relationship between E and z for this material too.

As a next step in the research a material was chosen with a mass number substantially greater than that for copper, namely silver (Ag). The nuclear data of the materials used are given in Table 3. The table also contains the Z-, N-, and $Z+N$-ratios used for the calculation of the exponential curves.

Table 3

NUCLEAR DATA OF STABLE ISOTOPES OF ELEMENTS USED IN CUBE COVER

Element	Number of Protons Z	Number of Neutrons N	Mass Number $Z+N$	Percent Abundance	Aver. of N	Aver. of $Z+N$	Values as Related to the Figures for Al as Unity		
							Z	Aver. of N	Aver. of $Z+N$
Al.....	13	14	27	100	14	27	1.0	1.0	1.0
Cu.....	29	34	63	69	34.6	63.6	2.23	2.47	2.36
		36	65	31					
Ag.....	47	60	107	51.4	61	108	3.62	4.36	4.0
		62	109	48.6					
Pb.....	82	122	204	1.3	125.6	207.6	6.32	8.98	7.7
		124	206	26					
		125	207	21					
		126	208	52					

The silver foil used in the experiments had a thickness of 120μ. Series S52+S53 were carried out with a single layer of this foil. The measured data are: $y'_o = 6.27$ cm., $K = 1380$ dynes, $E = 8540$ ergs. In the next series, S54+S55, a double silver layer was used, thus $z = 240\mu$. The results in these series were: $y'_o = 6.15$ cm., $K = 1940$ dynes, $E = 11{,}550$ ergs.

These energy values with 120μ and 240μ Ag likewise supported the theory about the exponential relationship between E and z, and in addition they give support to the nuclear proportionality theory, although it cannot be definitely established from the graphical representation in Figure 2 whether there is a correlation between the energies and *any one* of the nuclear ratios considered.

The next series, S56+S57, were made with a copper coating having a thickness of 600μ. The measured data are the following: $y'_o = 4.89$ cm., $K = 1770$ dynes, $E = 8060$ ergs. The energy is in fairly good accordance with expectation.

As there was a rather big gap in the values for aluminum, between $z = 150\mu$ and $z = 665\mu$, two series, S58+S59, were carried out with $z = 360\mu$ aluminum. They gave the results: $y'_o = 4.74$ cm., $K = 753$ dynes, $E = 3410$ ergs. It was estimated that this result did not call for a correction of the calculated exponential curve for aluminum.

At this point it was decided to try a material having a mass number still higher than that of silver. A series, S60, was carried out with a *lead* (Pb) cover of $s = 515\mu$, giving as results: $y'_o = 5.07$ cm., $K = 3060$ dynes, $E = 14{,}600$ ergs. This value, however, is far below that expected on the basis of the nuclear proportionality theory, which requires the values of 21,400, 30,200, and 26,100 ergs, respectively, for the ratios of Z, N, and $Z+N$. It was suspected that a rather compact oxide layer which was observable on the metal surface could have influenced the results. Therefore the series was repeated after a cleaning of the cube surface. In this new series, S61, the obtained data are: $y'_o = 7.18$ cm., $K = 2590$ dynes, $E = 17{,}500$ ergs. The cubes became smoother after the cleaning procedure and they traveled a longer distance in the X-direction, which explains the lower value of K in S61.

But also the new value of $E = 17{,}500$ ergs did not fit the theory very well, as it was too small.

My first reflection was that a limit for the energy E had been reached. However, a further study of the situation brought a new suggestion.

In Table 3, which contains the nuclear data of the elements chiefly used in the experiments, it is observed that the previous three metals Al, Cu, and Ag, have all *odd*-numbered *Z's* and *even*-numbered *N's*, whereas Pb has even-numbered *Z's* and even-numbered *N's*, except for Pb207 with 21 percent abundance, where N is odd-numbered. It is known from atomic physics that isotopes having both Z and N even-numbered are more stable than isotopes having odd-numbered *Z's* and even-numbered *N's*, or vice versa; i.e., they are less apt to react if exposed to a specific influence. This circumstance could provide an alternative explanation of why the results with lead are inferior to those expected on the basis of the theory. It was only by chance that the first three materials chosen all contain isotopes only of the odd-even type.

It was decided to pay attention to this point when choosing new materials for further research.

Meanwhile, two concluding series, S62+S63, were carried out with silver, using a coating thickness of $s = 480\mu$. The results, $y'_o = 5.77$ cm., $K = 2660$ dynes, and $E = 14{,}500$ ergs, are well in

accordance with the previous results and support the exponential theory as well as the nuclear proportionality theory.

After reflecting upon the conditions underlying the results in Figure 2, it was felt that a more appropriate way to study the energetical picture would be to fit an exponential curve to the three measured values for silver, because these values obviously show the closest approach to an exponential relationship among the three materials tested. This curve for silver then could be used as a basic curve instead of Curve 1 in Figure 2 for calculating the Z- and N-curves for Al and Cu on a nuclear proportionality basis. The system of curves arrived at is shown in Figure 3, and it is interesting to observe that the measured energies are in good agreement with the N-curves, but that they are substantially below the values indicated by the Z-curves.

This observation was estimated to be of such importance that it was decided to let it represent a working hypothesis to be tested in further work. On the basis of Figure 3 we therefore may postulate that there is a quantitative relationship between the energy and the *number of neutrons* in the material used in the cube cover.

At this stage of the research it was found advisable to look somewhat closer into the problem which had arisen in connection with the *lead* series; i.e., the decrease in the energy when using elements consisting to a major degree of even-even isotopes. A suitable way seemed to be to use elements in the cube cover having atomic numbers close to those of Al, Cu, and Ag, in order to compare the energy measurements with such materials with those obtained with the odd-even materials Al, Cu, and Ag. In the case of Al it was not possible to obtain magnesium (Mg) or silicon (Si) for comparison. But some series were conducted with zinc (Zn) and cadmium (Cd) for comparison with Cu and Ag, respectively.

In Series S64+S65 with 700μ Zn, the values $y'_o = 4.47$ cm., $K = 1235$ dynes, and $E = 5510$ ergs were obtained. This energy is 65 percent of the energy for 700μ Cu as given by the N-curve in Figure 3 (8500 ergs). If we make an adjustment for the higher average of $N = 35.4$ with Zn as compared with $N = 34.6$ with Cu, a percentage of about 63 results. The energy with zinc thus has been found to be considerably smaller than that with copper, a circumstance which supports the opinion gained on the basis of the lead

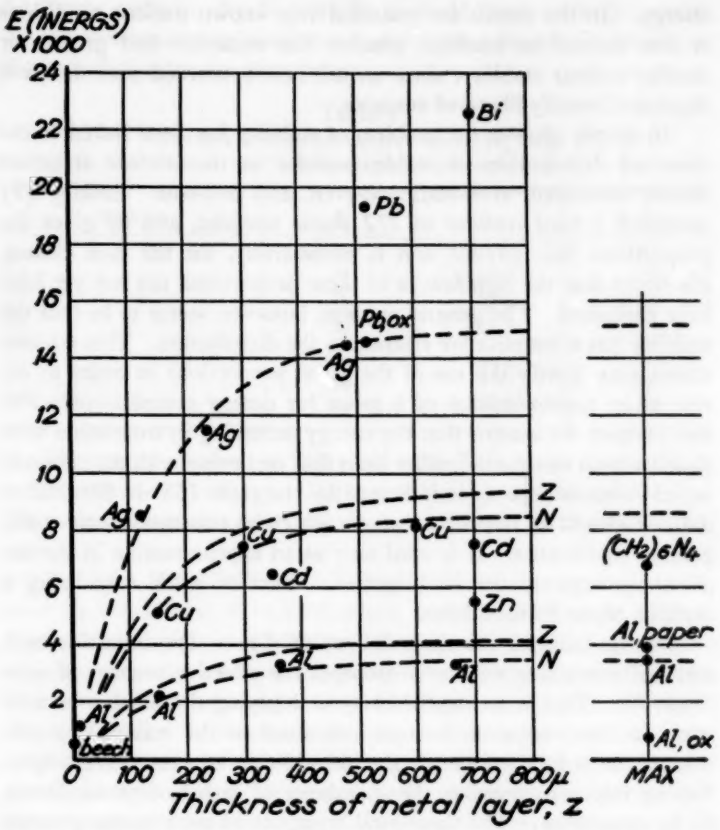


FIG. 3. Energy values for all materials tested. The exponential curves for proton (Z) and neutron (N) ratios are based on values measured with silver.

series that even-even isotopes in the material give rise to a lower energy than odd-even ones.

This was a new observation pointing in the direction that we are confronted with conditions associated with nuclear processes. It therefore seemed desirable to introduce a comparison which would reflect the new observation that the presence of even-even isotopes in the cube cover apparently had a limiting influence on the

energy. In the search for quantitatively known nuclear conditions it was decided to consider whether the materials had greater or smaller nuclear stability, since we are here concerned with different degrees of readily liberated energies.

In atomic physics the problem of stability has been linked to the observed distribution of stable nuclides in the nuclear structure classes even-even, even-odd, odd-even, and odd-odd. Stokley (9) considers a total number of 272 stable nuclides, and he gives the proportions 162, 55, 49, and 6, respectively, for the four classes. He states that the significance of these proportions has not yet been fully explained. The general opinion, however, seems to be that the stability has a quantitative relation to the distribution. This circumstance may justify the use of the given proportions in order to arrive at an approximation of a mean for energy comparisons. For this purpose we assume that the energy occurring in connection with an even-even isotope is smaller than that occurring with an even-odd or odd-even isotope as is indicated by the ratio $(55 + 49)/162 = .64$. It should be noted that we do not claim this ratio to have any general significance. It is used only as an approximation in the exploratory stage of the investigation. Further work may bring a decision about its usefulness.

On the basis of the ratio .64 we may now determine for each material containing even-even isotopes the effective number of neutrons, N_e. This is accomplished by multiplying the number of neutrons for the even-even isotopes contained in the material by .64, whereas no reduction is made for the odd-even or even-odd isotopes. Taking into consideration the abundance of each isotope we obtain N_e by summation. The theoretical energy to be used for comparison for a given material and for a given thickness z of the metal cover is obtained by multiplying the energy given by the exponential curve for silver according to Figure 3 with the ratio $N_e/61$, where 61 is the average number of neutrons with silver. The ratio $N_e/61$ has been calculated for the materials so far concerned and the results appear in Table 4. A correction has been introduced for the zinc cubes. These cubes were manufactured from 16×16 mm. zinc plates with thickness 700μ, which were soldered together with tin (Sn) along the edges. The surface thus consists partly of tin, and it has been calculated that the tin surface occupies about 5 percent of the

total cube surface. As N_e with Sn is about twice as large as with Zn it was necessary to bring in a correction for the calculation of the theoretical E-value for these cubes.

Table 4

EFFECTIVE NUMBER OF NEUTRONS, N_e AND CORRECTION FACTOR WITH SILVER AS UNITY

Element	Z	N_e	$N_e/61$
Al	13	14	.23
Cu	29	34.6	.57
Ag	47	61	1.00
Bi	83	126	2.07
Zn	30	23.2	..
Cd	48	47.1	.77
Sn	50	48.0	..
Pb	82	90.2	1.48
95% Zn + 5% Sn	..	24.4	.40

The energy obtained in S64+S65 with 700μ Zn is, as previously mentioned, $E = 5510$ ergs. The theoretical value is about 6000 ergs. Thus the measured energy is about 92 percent of the theoretical energy.

In Series S66+S67 with a 700μ cadmium cover we have measured $y'_o = 4.35$ cm., $K = 1740$ dynes, and $E = 7600$ ergs, whereas the theoretical value is 11,500 ergs, i.e., in this experiment we have obtained only about 66 percent of the theoretical energy. In Series S71 with a 350μ cadmium cover we have $y'_o = 5.75$ cm., $K = 1150$ dynes, and $E = 6600$ ergs. The theoretical value is in this case 10,450 ergs, and the measured energy is thus about 63 percent of the theoretical energy. There is good mutual agreement between the two values for cadmium, from the point of view of the exponential theory, although they are both substantially lower than expected according to the nuclear proportionality theory. It could be of interest in this connection to draw attention to the fact that cadmium is known to be an exceptionally strong absorber of slow (thermal) neutrons. Possibly this may be a fact to take into consideration when dealing more extensively with the energetical conditions at a later stage of the work.

With a 515μ lead cover in Series S61+S70 the measured values are $y'_o = 7.69$ cm., $K = 2680$ dynes, and $E = 19{,}350$ ergs. The theoretical energy is 21,600 ergs. The measured value thus is 90

percent of the theoretical value, which is about the same figure as found with the zinc cubes.

In Series S68+S69 with a 700μ bismuth (Bi) cover we have $y'_o = 8.64$ cm., $K = 2630$ dynes, and $E = 22{,}700$ ergs. This material consists of a single odd-even isotope, and the theoretical value therefore should be equal to the energy for silver according to the exponential curve in Figure 3, multiplied by the direct neutron number ratio for bismuth and silver, i.e., 2.07. We arrive in this case at a theoretical value of 31,000 ergs.

A point to be mentioned here is that the lateral deviation with bismuth, $2y'_o = 17.28$ cm., is the greatest so far observed with the experimental conditions used in this research. There is some suspicion that the mechanical limits of the conditions may have a restrictive effect on the deviation when it reaches very high values, and that this circumstance has to some extent been responsible for the comparatively low energy value with bismuth.

The results obtained with the "even-even" materials naturally made it desirable to look for some material containing an odd-odd isotope, because there was reason to believe that experiments with such a material could bring new aspects to light. In atomic physics odd-odd isotopes are considered to be rather unstable, and it could therefore, according to the previous findings, be expected that comparatively great energies would show up in a placement experiment when using cubes containing substantial quantities of odd-odd isotopes.

In this connection three of the light elements could be considered, namely lithium (Li), boron (B), and nitrogen (N). It was found advisable to consider nitrogen first because it contains almost 100 percent of the odd-odd isotope N14, with $Z = 7$ and $N = 7$. The percentages of odd-odd isotopes in lithium and boron are much smaller.

Chemical compounds exist which contain a relatively high proportion of nitrogen. A suitable one was conveniently available in powder form, hexamethylenetetramine, $(CH_2)_6N_4$, which has about 40 percent nitrogen. Sixteen millimeter cubes of sufficient mechanical strength were obtained through a pressing procedure.

Two standard series, S72+S73, were conducted with these cubes, giving as results: $y'_o = 8.57$ cm., $K = 798$ dynes, $E = 6850$ ergs.

It is of interest here to determine to what relative extent the nitrogen was responsible for the measured energy. We maintain in our previous hypothesis that E is proportional to the number of neutrons. The carbon (C) consists of about 99 percent of the even-even isotope C12, with $Z = 6$ and $N = 6$. Due to the high proportion of C12 we may for an approximate calculation disregard the one percent C13. The two hydrogen (H_2) atoms have no neutrons and it is therefore assumed they do not play a part in the energetical process. Using, as before, the data with silver as a basis we have the following equation:

$$(.6 \cdot 6 \cdot .64 + .4 \cdot 7 \cdot n) \,/\, 61 = 6850 \,/\, 15200.$$

where .6 = relative abundance of C in material
6 = number of neutrons with C
.64 = energy coefficient with the even-even C
.4 = relative abundance of N in material
7 = number of neutrons with N
n = energy coefficient with the odd-odd N
61 = number of neutrons with Ag
6850 = measured energy, $E=E_m$, with the material $(CH_2)_6N_4$
15,200 = E_m with Ag

The energy coefficient n with N is calculated from the above expression as $n = 9.0$. This would mean that with the odd-odd nitrogen the obtained energy, per neutron in the nucleus, is $9/.64 = 14$ times as great as with the even-even carbon. This result is at least qualitatively in accordance with what could be expected from the present knowledge of nuclear stability conditions, and it consequently strengthens the opinion that the PK process is related to nuclear conditions.

The experiments with materials containing even-even and odd-odd isotopes are still in an exploratory stage, and a further discussion of the results obtained with these materials will therefore have to be put off. The following section will be devoted to a discussion of the results obtained with the "odd-even" materials aluminum, copper, and silver. These results seem to be sufficiently comprehensive and consistent in their trends as to allow for an extensive discussion from a theoretical point of view.

In Figures 4a and 4b we have presented all energy values with

Al, Cu, and Ag on a percentage basis for comparison with the exponential curve, computed on the basis of the energies obtained with silver. It is observed that when the neutron numbers are taken as a basis (Figure 4b), the agreement between the measured energy values and the values according to the exponential curve is far closer than when the proton numbers are considered (Figure 4a).

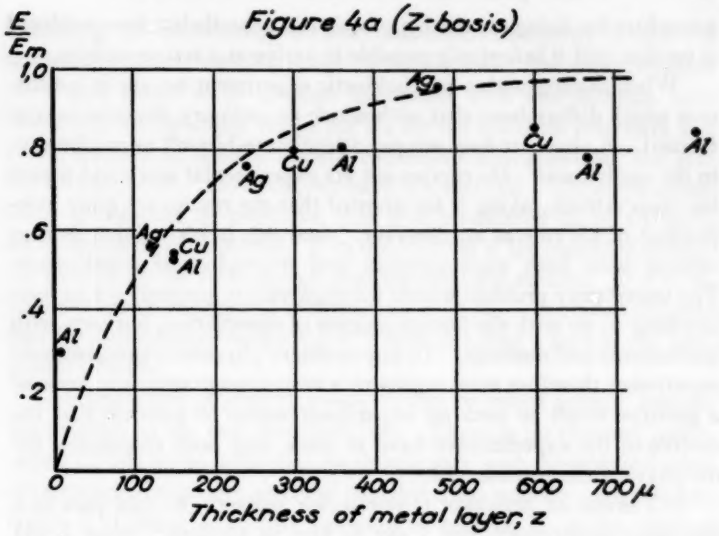
Discussion

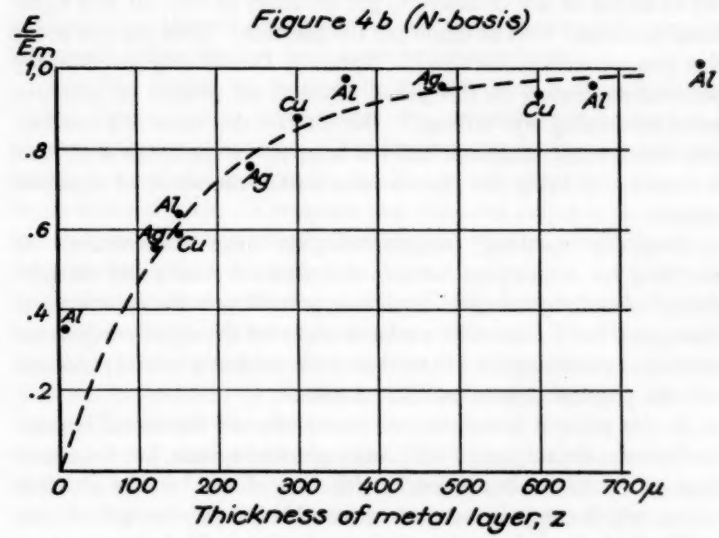
It is clear from the preceding section that there has been a successive adjustment of the working hypotheses in the course of the experimental work. This gives an idea of the complexity of the problem with which we are concerned. The experiments are rather time-consuming, and if solutions are to be expected within a reasonable time, the most economical procedure seems to be to revise the hypothetical picture as the experimental work advances. This empirical development of results and hypotheses simultaneously is what has been presented in the preceding section. Now we intend to survey the material on a broader basis, looking for theories which appear to be useful for the further advancement of the research.

Several suggestions made in the following paragraphs necessarily must be considered at present as having a more or less hypothetical character. The considerations presented do not make definite claims for the validity of a certain theory, but rather survey the problem from different angles in an attempt to establish lines for further experiments.

Before we enter into a detailed discussion of the experimental results, let us face some general considerations to be recognized in a research such as the present one, where we are not only confronted with the results of a physical investigation but where we have to assume that psychological conditions as well have had an influence on the data arrived at.

The readers who are acquainted with the previous placement work may have observed that we have in these investigations followed a line of inquiry which is well established in science. This method requires that it must be possible to test a hypothesis by experiment. At least in principle the experimenter should be able to verify or falsify it. If one cannot at the moment indicate a definite experimental





FIGS. 4a and 4b. Energy values for aluminum, copper, and silver on a percentage basis compared with exponential energy curve with the silver values as standard, and for proportionality between energy and proton numbers (in 4a) and between energy and neutron numbers (in 4b).

procedure for doing so, the hypothesis can nevertheless be considered if we find that it is *logically* possible to arrive at a test procedure.

When dealing with a psychokinetic experiment we are in a situation which differs from that with which an ordinary physicist is confronted. A physicist does not pay attention to himself as an observer in the experiment. He carries out his experimental work and makes his observations, taking it for granted that the results are quite independent of his role as an observer. And this is his opinion in connection with both macrophysical and microphysical experiments. The uncertainty problem within microphysics is assumed not to have anything to do with the human process of observation, but only with instruments and methods. To any ordinary physicist a psychokinesis experiment therefore must represent a very strange situation, because a positive result in such an experiment seems to indicate that the desires of the experimenter have in some way been responsible for the physical effects observed.

If I invite an orthodox physicist, for instance, to take part in a placement experiment, and I say to him in advance: "Now I will try by an act of will or desire to get the cubes to veer off in a right-hand direction," then he might put the question: "How can you prove that you are willing just this?" Naturally I could only give him my personal assurances on this point. I could not present an objective proof concerning my "willing." But the fact that there is a relationship between my statement and the behavior of the cubes is all that is required to bring the phenomenon within the scope of objective science.

Generally speaking parapsychologists have concentrated on searching for connections between the obtained results and the psychological and physiological conditions prevailing in the experimental situation. But I think that we have neglected the equally important questions concerning the interaction of the subject's mental processes with the physical objects used in psi tests.

In this paper it is my purpose to explore, not the causal interaction between the subject's "will" and a physical system, but the causal chain of events set in motion by this "act of will" in the physical system, which events in turn are responsible for the observed effects.

The basic formula used in the investigation so far is

$$E = E_m(1 - e^{-as}) \tag{2}$$

indicating the relationship between the observed energy E and the thickness z of the metallic cover on the cubes. The measurements have been found to be in good agreement with this formula, provided that we introduce values for E_m for the different materials in a given relation to specific nuclear conditions characterizing the material in question. However, we have not varied a. The good agreement is obtained on condition that a is considered to be constant, independent of the material. E in the formula is the *absorbed* energy, E_m then being the total energy entering the cube surface. If $z = \infty$, then the whole energy is absorbed, i.e., $E = E_m$. We have assumed that the *transmitted* energy $E_m \cdot e^{-az}$ does not play a part in the energetical process.

An important objection, however, can be raised against treating the problem in the way described here. There is no physical justification for the assumption that E_m should vary with the material when we consider the energy as being supplied from outside. On the contrary, it is plausible in this situation to assume E_m to be constant and independent of the material if we are to remain on a recognized physical basis, because the cube material cannot have an influence on the energy before the two have come into interaction.

For this reason we propose to advance here a *second theory* which, however, also incorporates the principle relationship expressed in the basic formula. This does not assume that the primary energy is supplied from outside, but that it is in some way liberated in the material itself. It supposes that the mind action is of a relaying kind that is able to start an energetical process within the atom but does not convey any energy to it.

In this new theory we designate by E_o the energy released in the material per unit of time and of layer thickness. This energy, released in a thin layer with thickness dz within the material, then, is constant, independent of the distance of the layer from the cube surface. This means that E_o is evenly distributed within the whole material. Say that the energy has to be transferred to the surface of the cube in order to enable a mechanical action outside the material. Then we can expect that a part of the energy will be absorbed in the material on the way out and that the remaining part E is emitted and is responsible for the observed action.

The initial energy of any layer dz is $E_o \cdot dz$. The part of this energy which reaches the surface after having passed the distance z is

$$dE = E_o \cdot e^{-az} dz \tag{3}$$

Integrating between 0 and z we get the total emitted energy

$$E = \frac{E_o}{a} (1 - e^{-az}) \tag{4}$$

This formula represents the same functional relationship between the emitted energy E and the released energy E_o as we previously had between the absorbed energy E and the entering energy E_m. In this new theory, however, we need not assume E_o to be independent of the material. On the contrary, as the energy is considered to be released in the material, it is plausible to admit that it is dependent on the atomic conditions.

We have previously mentioned that the measured energies comply well with the exponential formula on condition that a is constant, independent of the material. In the case of a physical radiation a normally has the character of an absorption coefficient, mainly depending on the properties of the material. Its *general* constancy in the present case thus is somewhat confusing.

We will therefore deal here also with a *third theory,* which for different reasons seems interesting, although it is difficult to say yet whether it is in fact a testable hypothesis or whether it has to be classed more as a speculation.

Say that the energy, as in the second theory, is released within the material, and is not evenly distributed over the layer thickness z but is distributed according to the equation:

$$E_o = E_1 \cdot e^{-az} \tag{5}$$

i.e., E_o decreases from E_1 at $z=0$ to 0 at $z = \infty$. If we do not consider any absorption, but assume that the released energy is in its entirety used for the production of the observed dynamical effects, then we arrive at the formula:

$$E = \frac{E_1}{a} (1 - e^{-az}) \tag{6}$$

which also represents the basic relationship with which the measurements have been shown to agree.

The evaluation of the measured data has given strength to the hypothesis that PK involves microphysical processes. The circumstance that we cannot trace any relationship between the energies with different materials and known conditions as concerns the absorption of radiant energy (a has so far not shown any dependence on the material) suggests that we can hardly consider a as an ordinary physical constant. There is reason to believe that the exponential relationship found in these experiments is not entirely bound up with physics, but that it involves a psychological aspect too; however, not in the sense that the subject merely regulates his efforts, consciously or unconsciously, so that an exponential relationship is obtained. The matter may involve a much more far-reaching concept.

It has on several occasions been pointed out, originally by Jordan (6), that there is a marked correspondence between the conditions in quantum mechanics and in parapsychological experiences, mainly as concerns complementarity. This is in quantum mechanics linked up with the uncertainty relations. In parapsychology a corresponding effect may be represented by the so-called chronological decline in the extrachance effects in quantitative experiments. Concerning this effect the opinion has been expressed that the chronological decline is not due to a decline in the subject's efforts, although no explanation seems to have been offered so far concerning its real cause.

It is a question whether we are here confronted with a process which depends entirely upon the subject, and possibly upon other participants in the experiment—that is, upon the human conditions—whether it also represents an aspect of some generally acting principle.

Since chronological declines are found not only in ESP but in PK as well (e.g., see 1, 2), it may be inferred that the decline has not only a psychological aspect, but that it has a connection with matter too. The findings in the present report indicate that there seems to be a connection with the *microphysical* aspect of matter.

In the third theory we have introduced the proposal that the energy may not be constant throughout the material, but that it varies with the thickness z. The suggestion is that the building up of the energy E_0 in the metal layer can be considered as a successive microphysical process which is continuously influenced by a principle whose effect decreases in proportion to the development of

the process. The energy released in the layer with thickness dz therefore is getting smaller as z increases.

If this principle is considered to be independent of the psychological conditions of the participants in the experiment, then we may expect that it has certain lawful effects which, under the prevailing conditions, may result in an exponential relationship. It would seem that in the third theory we would have to consider the exponential relationship as representing such a principle. It is interesting to observe that "guiding principles" are often considered in the philosophy of modern physics, for instance by C. F. von Weizsäcker (**10**, p. 15 ff.).

The fact that it has been possible to fit the measured energies so well into typical mathematical relationships strongly supports the opinion that the cause of the effects observed can not exclusively be ascribed to subjective psychological conditions. This is because it seems very difficult to admit such a high degree of constancy in the psychological aim of the experimenter that results arrived at could so well be fitted into a theoretical system of a recognized kind.

In this connection attention has to be given to the circumstance that the calculation of the energy E in every case involved a complicated mathematical analysis which could not be carried out before each series was terminated. Furthermore, the cubes were in practically all instances weighed only *after* the series. Basic physical data necessary for the calculation of E therefore were unknown to the experimenter as long as the series was under development. These factors, too, seem to argue against a purely psychological explanation.

The third theory involves the postulate of an absorptionless or absorption-poor energy transmission through matter. In this paper I shall not discuss how this may result in the observed deviations. One possibility is that an emission of neutrons from the cube material is effected in such a way that its reaction on the cube acts preponderantly in a direction to produce the observed deviation. However, the problem is in need of further theoretical investigation, for which convenient physical experimental procedures would have to be adopted.

All considerations in this new research have so far been based on the experimental results computed as the average in a series.

Thus, there are as a rule 120 individual cube positions providing the basis for the calculation of one single *E*-value. As six cubes are released simultaneously, there are consequently 20 different cube distributions included. There are great differences in these distributions within a series, and only occasionally is a movement in the desired direction obtained by the aggregate as a whole. PK forces thus are not acting on each cube in the specified direction, but the ultimate effect is brought about in a complicated manner as an over-all result. It is obvious that there is in each release of the six cubes a choice of dynamical procedure which is beyond the conscious control of the experimenter. This free choice of procedure probably represents a basic condition for obtaining results in a PK experiment. It is interesting in this connection to recall the statement by Dr. J. B. Rhine, that psi always acts on an unconscious level.

According to these observations we cannot consider the side force *K* as a real force acting sideways on the whole cube aggregate during its entire movement. *K* has only the character of a measure which is convenient for the comparison of the results of whole series. The real forces occurring in the different releases seem to be of a very complex nature, but it is interesting to observe that their combined effects in a series are subject to a pronounced lawfulness. Direct observations of the cube movements give bearing to the opinion that the real forces are often of a mutation-like kind; i.e., that they are acting during a very short time at some point in the course of the travel of the cube aggregate.

Additional Remarks

The present paper has been discussed with several atomic and theoretical physicists. Some objections have been raised against a hypothesis based on a neutron emission from the cube material. On the basis of calculations it has been found that such an emission would have to be comparatively strong to be able to account for the observed deviations and it should be easily possible to detect secondary radiation effects resulting from it by investigating the cube surface with a Geiger device immediately after the experiment.

In line with this suggestion, radiation measurements have been carried out under different experimental conditions, but in no case have effects been observed which could not be attributed to normal

cosmic radiation. At present, therefore, it looks as if the hypothesis of a neutron emission must be abandoned.

In order to investigate whether the effects on the cubes were of magnetic nature a set-up has been used in which the cubes moved through an induction coil, the electrical effects in which were measured with an oscilloscope. So far these measurements have not brought anything to light which indicates that magnetic forces are involved in the PK process.

It should be noted that these findings do not cast doubt on the empirical fact that a relationship has been established between the energies and the number of neutrons with different cube materials. By means of the measurements we have merely made more improbable special hypotheses suggested by this relationship.

Before terminating this paper one further point should be mentioned. The ratio between the atomic weight and the specific weight for a solid changes with the material, because of the fact that the concentration of the atoms or molecules is different in different materials. This is due to differences in crystalline structure. The number of atoms per unit of thickness of the cube coating therefore varies with the material. On the basis of the weight ratio it is found that the number of atoms to be considered is about the same for Al and Ag, but almost 50 percent greater in the case of Cu.

It is interesting to observe that in spite of the greater concentration of the atoms with Cu, all three energy measurements with this material follow the proportionality rule rather well, taking into account the number of neutrons in the atomic nucleus. This circumstance supports the opinion that the PK effect is not connected with the *mechanical* properties of the material. Otherwise almost 50 percent higher energies should have been expected with Cu than those actually measured. Another way of expressing this is to say that there seems to be an influence associated with the mathematical properties of the cube coating. And this is in line with the findings as related to the nuclear conditions because atomic physics, as it stands today, is a science dealing with mathematical relationships rather than with matter in the macrophysical sense.

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A TEST OF ADDING EXTRASENSORIALLY PERCEIVED DIGITS[1]

By CATHERINE S. NASH AND CARROLL B. NASH

ABSTRACT: This experiment is an exploratory study designed to determine whether the subjects in a clairvoyance test could respond to more complex targets than the simple stimuli customarily used in ESP experiments. Part of the targets which the subjects were asked to identify were single-digit numbers. The rest, however, were problems in adding two digits which were knowable only by ESP. There was a significant deviation on the single-digit targets and only chance results on the problems in addition. The results are consistent with two hypotheses: (1) The response to the more complex targets was not a "diametric" process; that is, the correct answer was not arrived at by a single act of ESP. (2) The subject had to identify separately by ESP each of the two digits to be added and therefore he would not be expected to get as many hits as he would if the target were perceived as a unit.

One of the authors, Dr. C. B. Nash, has published a number of articles in the Journal. The other author, Mrs. C. S. Nash, is his wife and is Assistant Professor of Biology at St. Joseph's College.—Ed.

INTRODUCTION

THE EXPERIMENT was performed to throw further light upon the question of whether ESP is a response to a simple stimulus or whether it may encompass a complex target situation. The purpose of an earlier experiment with multiple-digit targets (3) was to determine how ESP subjects react to composite targets. The purpose of the present tests was to ascertain whether the ESP response might encompass a simple arithmetical calculation, specifically the addition of single-digit numbers knowable only by ESP.

PROCEDURE

The experiment was conducted in 1957-58 with the 38 students in C.B.N.'s course in General Biology at St. Joseph's College as subjects. Ten ESP runs were given individually to each student who completed the course, as was the plan from the beginning. Of the 38 subjects who began the tests, 31 finished. A total of 340

[1] This research was supported by a grant from the Parapsychology Foundation, Inc. It was first reported at the convention of the Parapsychological Association, on September 5, 1958.

runs were performed, the results of all of the subjects being included in this report.

The targets consisted of the digits 1 to 5 and of the following problems in addition: 0+1, 1+1, 2+1, 2+2, and 2+3. These 10 kinds of targets were arranged in random order with the use of a table of random numbers (2) and the 20 targets for each run were recorded by an assistant in two columns of 10 on a 2″ × 5″ card. C.B.N. covered both sides of the target with opaque paper and clipped a blank record card on top for recording the subject's calls. The targets of the run were not known to the experimenter (C.S.N.) until the run was completed.

The experimenter was alone with the subject during the run. She informed him of the nature of the targets and told him to respond to each by calling a digit from 1 to 5. She wrote his name and the date on the record card and recorded his calls on it in two columns of 10. Immediately before each run except the first she gave him the score of his previous run. The results of the experiment were independently checked.

The 31 subjects who completed the tests were given the Guilford-Zimmerman Temperament Survey (1) which measures the following 10 personality traits: general activity, restraint, ascendance, sociability, emotional stability, objectivity, friendliness, thoughtfulness, personal relations, and masculinity. Scores were obtained for 29 of these subjects on the American Council of Education Psychological Examination for College Freshmen, which measures mental alertness, with separate scores for quantitative and linguistic abilities.

Results

The results of the ESP tests are as follows:

	Trials	Hits	Dev.	CR
Single-Digit Targets	3419	622	−61.8	2.65
Problems in Addition	3381	683	+ 6.8	0.29

Correlations between the 12 psychological factors and the ESP scores yielded nothing of interest.

Discussion

The significant deviation with the single-digit targets indicates the presence of ESP in that part of the experiment (in the form of

psi-missing). The absence of a significant deviation in the addition tests seems to indicate that the subjects were not able to give the correct sum when the numbers to be added were knowable only by ESP. The interpretation of the chance results in this part of the experiment must allow for the possibility that psi-missing might have been occurring on the additions trials as well.

The results of the addition trials are consistent with either one of the following two hypotheses:

(1) The subjects responded by ESP to the individual digits to be added, but their success (assuming that it was at the same level as that achieved in the single-digit trials) could not produce any appreciable deviation in the *sums*, the only responses permitted in these trials. This statement would be true regardless of whether the subjects responded to the separate digits to be added by ESP-hitting or by ESP-missing. In the former case, the subjects would have to get *both digits correct* to get the sum correct, and this was quite unlikely to occur in view of the generally low probability of the occurrence of ESP on each digit considered singly. In the latter case (psi-missing), the sums would likewise not be affected to any appreciable degree.

(2) Chance results were obtained on the additions trials either because the psychological conditions were not favorable for the occurrence of ESP or because the subjects were not able to perform the additions by means of a diametric or unitary function of ESP. If ESP had operated in a diametric manner upon the two digits of the addition targets, there is no logical reason why the results should not have been as significant as those from the single-digit targets. Also, there is no known reason why psi-missing might not take place even with a diametric ESP response. Thus the deviation for the sums might in this case have been significantly negative. All that can definitely be said is that in the present experiment the addition of numbers did *not* occur as a diametric or unitary psi function; that is, the two digits of the addition targets were not grasped by a single act of ESP.

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Numbers. Tracts for Computers XXIV. London: Cambridge University Press, 1939.

3. NASH, C. B., AND DURKIN, M. G. Terminal salience and multiple-digit targets. *J. Parapsychol.*, 1959, 23, 49-53.

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A PROBABILISTIC MODEL FOR ESP

By N. T. GRIDGEMAN

ABSTRACT: A subject guessing ESP cards is assumed to be characterized by a parameter p_e, namely, an empirical probability of genuine but subconscious "recognition" of a particular card. Over and above the score achieved in this manner by ESP, some hits will be made fortuitously. Using this concept, the author presents the mathematical formulas for estimating the ESP probability for each card from the data of any given test and the variance of this estimation. It is suggested that these estimations of the empirical ESP probability should be of general interest in connection with tests that yield statistically significant ESP results.

Mr. Gridgeman is a biometrist in the Division of Applied Biology, National Research Council of Canada.—Ed.

INTRODUCTION

SOAL AND BATEMAN, in their compendium of experimental telepathy (4), briefly remark that above-chance success in attempts at extrasensory card identification might be broken down as follows: Suppose that the subject "knows completely a certain number of cards by ESP, and the correct hits which he obtains on the remainder are the result of chance." On this basis they define an "intrinsic (percentage) rate of scoring," which for a five-symbol deck is $25(5r - n)/n$, where r is the number of hits in n trials. They admit however that "the logic of the proceeding is full of flaws and we use the formula only in default of a better method." Our purpose here is to tailor this concept to a probabilistic model.

THE MODEL

Let us assume, not that the subject "knows completely" some cards, but that he has a *specific probability* of "knowing" each card. In the homologous field of sensory perception a similar probability is often invoked. For instance, a pair of sensory stimuli can be so chosen that the difference between them is *neither* obvious *nor* imperceptible. Thus if the pair comparison is replicated n times (by the same subject) the number r of correct responses to the question (say), "Which is the brighter light?" can turn out to be less than n but significantly greater than $n/2$, the number expected by chance

alone. In other words the subject must sometimes be perceiving and at other times guessing, and yet be unaware of which responses are which. (We assume of course that all possible sources of bias, such as position, time order, and so forth, are eliminated, either physically or by the way of an appropriately balanced experimental design.) This phenomenon of subliminal perception has been called *subception* (1). It is curious, slightly puzzling, but can be interpreted in rational terms.

A model for sensory pair comparison in the above context is given in reference (3):

$$E(r/n) = p = (1 + p_s)/2 \tag{1}$$

where p_s is an empirical probability of subception, specific to contrast and subject. Let us extend this notion to ESP card trials. Take a pack of cards of s equally represented suits (symbols), and define p_s as the probability of subception of a card. Among the unsubceived cards there will be a probability $1/s$ of a chance hit. Thus in a run of n trials the observed number of hits r will be conditioned by

$$E(r/n) = p = p_s + (1 - p_s)/s \tag{2}$$

so that an estimate of p_s is given by

$$\hat{p}_s = \frac{sr - n}{n(s-1)} \tag{3}$$

which expression, with $s = 5$, becomes Soal and Bateman's intrinsic scoring rate, as a proportion. The above formula is essentially the same as the formula presented by Foster (2). Now as p_s is a linear function of p, it follows that

$$\text{var}(\hat{p}_s) = \frac{\text{var}(\hat{p})}{(1 - 1/s)^2} = \frac{p(1-p)/n}{(1-1/s)^2} \tag{4}$$

so that the best available estimate of the standard error of $\hat{p}_s$ is

$$SE(\hat{p}_s) = \frac{s-1}{s}\sqrt{\frac{r(n-r)}{n^3}} \tag{5}$$

The probability of exactly r hits is

$$P(r;n) = \binom{n}{r}(s-1)^{n-r}(1-p_s)^{n-r}(1 - p_s + sp_s)^r s^{-n} \tag{6}$$

Equation (6) can be looked upon as the probability of r hits

with a subject who is characterized by the parameter p_e. Note that when p_e is zero, (6) reduces to

$$(7) \qquad P(r;n) = \binom{n}{r} \frac{(s-1)^{n-r}}{s^n}$$

which is the binomial expression used to calculate chance expectation of hits with an s-suit pack.

Use of the Model

The empirical p_e is a parameter of ESP in the context of simple identification trials. The traditional purpose of such trials is to test the null hypothesis that p_e is zero. With the model here proposed, the investigator, having satisfied himself that the null hypothesis is untenable, can go on to *estimate* p_e and its limits of error.

The parameter p_e may be used to characterize subjects, and it is a suitable quantity to study in regard to such conjectural influences as size and shape and color of card symbols, displacement, varying test conditions, *et hoc genus omne*.

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2. Foster, A. A. A perception ratio for ESP tests. *J. Parapsychol.*, 1940, **4**, 320-24.
3. Gridgeman, N. T. Sensory item sorting. *Biometrics*, 1959, **15** (in press).
4. Soal, S. G., and Bateman, F. *Modern Experiments in Telepathy*. London: Faber & Faber, 1954.

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COMMENTS AND LETTERS

Experimental Objectives of the Anderson-White Work with School Children

Dear Miss Anderson and Miss White:

I have just been reading your article: "A Survey of Work on ESP and Teacher-Pupil Attitudes," in the *Journal of Parapsychology,* December, 1958.

I need considerable enlightenment in understanding where this study leaves us. I have been completely convinced by the earlier studies that you had real ESP by the tail, and that you had two very powerful factors: teacher attitude, pupil attitude, and indeed the interactions of these as two parameters, giving rise to ESP. It is not clear to me in what sense the present group of investigations are "exploratory," in what sense the others are not exploratory, and it is not clear to me how these studies differ psychologically from those which gave such dramatic positive results. On the one hand, there is emphasis in the present paper on the "experimental variations introduced from our original design," but lower on the same page (247) one learns that "the method of testing used in all the experiments summarized here is essentially the same as that used in our original work." Apparently there were various factors of attitude in the broad sense, which were held to be different in the significant and the nonsignificant series. If this were foreseen, you would expect that the hypotheses written down in advance would be quoted here. If the differences were not foreseen, it is not clear in what sense these studies can be called exploratory and handled in a second category. While it is true that many of these studies give results in the expected direction, the differences are usually slight and some are in the unexpected direction, and no one could possibly regard this block of studies as randomly selected from the same master population of studies which yielded the more successful ones already published. It becomes, therefore, imperative *to know what the psychological distinction is,* other than the sheer statistical fact that one group brought in the gravy and the other didn't. It is also important to know what the plans might be for cross-validation, to see

if any hunches about the rather unsuccessful results obtained here will be borne out by independent work involving no selection of data.

I don't personally believe that the significance level or the psychological meaning of the earlier successful studies is going to be much affected, but I think you have to protect yourself by a fuller statement as to the logic of the separation of the earlier studies from the present ones. Can you set me right on this?

Sincerely,
(Signed) Gardner Murphy

Dear Dr. Murphy:

Our first school experiment was designed to test the teacher-pupil attitude factor in relation to ESP scoring in academic classes of the public high schools. On the basis of the results from the first study, we set out to *confirm* our findings, which we did in the following two series. In each of these three series, all of the aspects of the test were the same (to the extent that the word is ever justified).

Having these studies behind us and being rather well convinced by them, as well as by those of others, that psi does occur in the classroom, we wanted, and thought it would be valuable, to do some *exploring*. We discussed our plans with colleagues here in the Laboratory and, with their added thoughts and suggestions, proceeded with our research.

We should have amplified our statements that these new experiments were "divergent in design from our original research" (p. 246) and that "the method of testing used . . . is essentially the same" (p. 247). We wrongly assumed that our meaning would become evident to the reader as he considered each of the studies presented. Your pointing out of this lack of clarity on our part gives us the opportunity to explain more fully. The experiments were "divergent in design" in that each of the studies was carried out under conditions which differed contextually from the original series. We (1) tested for precognition in two of the series; we (2) presented the test to nonacademic students and students in a reform school; we (3) utilized teachers who had taken part in the school experiments before and who were, therefore, familiar with the school work; we (4) had two teachers test several classes rather than just

one; and we (5) placed the experiment in two studies in the hands of someone connected with the school who in turn carried out the study.

While we could not say that we *knew* these variations from our original theme would reveal various factors of attitude in the broad sense which would be different from our confirmatory work, we certainly did anticipate this. That this was not so stated is unfortunate.

There are plans now for further studies with, for example, nonacademic students. Our usual test for clairvoyance can be used, but we feel that if we would direct the test to the nonacademic classes in terms of the "play" aspect or less academic nature of the situation, we might find results in accord with our first three series. You may recall that van Busschbach found that his test worked at the fifth- and sixth-grade level but not with seventh- and eighth-grade pupils, who thought the whole thing "silly." It appears that an ESP test to be effective must *fit* the classroom situation from every standpoint. Cross-validation of these exploratory studies may be expected to furnish more answers than are now available.

Sincerely yours,
(Signed) Margaret Anderson

Some Comments Apropos of Pooling

To the Editors:

In the article "Some Avoidable Misconceptions in Parapsychology" in the March, 1959, issue,[1] Rhine states in the section titled "The Pooling Fallacy" that: "the implication is that no unit of work relying on statistics, no matter how independently conducted nor how well designed, can be considered entirely by itself." I would like to cite a case where the level of significance for a single ESP experiment is so high that pooling it with a great number of total failures would still result in a high statistical significance for the overall group of experiments.

In particular I refer to the Soal and Bateman[2,3] series where a

[1] Rhine, J. B. Some avoidable misconceptions in parapsychology. *J. Parapsychol.*, 1959, **23**, 30-43.
[2] Schmeidler, G. R., and McConnell, R. A. *ESP and Personality Patterns.* New Haven: Yale University Press, 1958. (See p. 13.)
[3] Soal, S. G., and Bateman, F. *Modern Experiments in Telepathy.* New Haven: Yale University Press, 1954; London: Faber and Faber, 1954.

probability of less than one part in 10^{35} was obtained. The question I raise is: How many nonsignificant tests of ESP by independent investigators could be pooled with this one series and still leave the probability at below, for example, the .001 level?

Using a method devised by R. A. Fisher,[4,5] it is possible to combine the probability values from a set of N independent experiments into a single overall probability based on the chi-square distribution with 2N degrees of freedom.

If we assume that all of the other experiments taken *together* had a pooled probability of .25 (i.e., a very nonsignificant value), and ask how many such experiments there could be, and still have the overall set significant at the .001 level when the Soal and Bateman experiment was included in amongst them, we find that this number can be about a thousand.

This may be easily verified by approximating chi-square[6] with:

$$n\left(1+\frac{2}{9n}+Z_a\sqrt{\frac{2}{9n}}\right)^3$$

where n is the number of degrees of freedom, Z is the normal deviate, and a is the significance level.

If we then let

$$\chi^2_{.001} = 2(2.30258)(\log_{10}10^{35}) + \chi^2_{.05}$$

and substitute $n = 2002$ on the left and $n = 2000$ on the right to obtain the two respective values of chi-square, we find that:

$$2200 < 161 + 2042.$$

The right-hand member is larger than the left, which means that we could have used a still larger N than 1000.

Thus, if the Soal and Bateman series had been pooled with the results of over a thousand other investigators, none of whose works were significant, we would still obtain significance at the .001 level for the over-all series. A very interesting finding, I think, which

[4] Fisher, R. A. *Statistical Methods for Research Workers.* New York: Hofner, 1948.

[5] Jones, L. V., and Fiske, D. W. Models for testing the significance of combined results. *Psychol. Bull.*, 1953, **50**, 375-82.

[6] Dixon, W. J., and Massey, F. J. *Introduction to Statistical Analysis.* Second Edition. New York: McGraw-Hill, 1956. (See p. 385.)

could readily be extended to include such other highly significant experiments as the Riess and Pearce-Pratt series.

Sincerely yours,
(Signed) John R. B. Whittlesey

To the Editors:

I should like to make a few remarks regarding the comments on pooling in J. R. B. Whittlesey's letter.

Just what do we mean by pooling? I can think of three useful definitions of the process, each useful in its particular application and by no means equally sensitive when used outside its defined field of application. They are as follows (I shall discuss these in terms of application to ESP series):

(i) A population exhibits ESP as a general rule, although perhaps of a very low order. Then an efficient test is to lump or pool all results together so that all individual series results are lost as to identity and treatment. An ordinary CR on the mean of the total results is the method of significance testing.

(ii) A number of the series are expected to exhibit ESP. Method (i) would likely be inefficient in that it would dilute the effect drastically. The Fisher chi-square combination method would be appropriate. (This is the method used by Whittlesey, but it is quite inefficient when applied to just one significant series out of a large number of series.)

(iii) For the third interpretation the problem can be stated as follows: What is the probability P that in N series one or more will be found by chance to have a calculated probability as small as p? It is easy to prove that $P < Np$. Let us apply this result to the case calculated by Whittlesey.

Set $p = 10^{-35}$, $N = 10^{32}$. Then $P < Np = 10^{-3} = 0.001$.

In other words, with a background of 10^{32} series the significance probability is still 0.001 or less under interpretation (iii).

(Signed) Joseph A. Greenwood

Current Thought and Parapsychology

To the Editors:

For some time now I have been pondering a correlation between growth of interest in parapsychology and the wildness of criticisms by die-hard mechanists.

I think the long, hard fight by the small corps of investigators at Duke and elsewhere may indeed be bearing fruit. More and more books and articles are appearing which either take up the cudgels for parapsychology or are indirectly helpful by attacking the foundations of the mathematico-mechanistic orthodoxy. Illustrations of this trend are to be seen in "Scientists with Half-closed Minds" by Ian Stevenson in *Harper's,* Nov., 1958; "A Scientist Ponders Faith" by Warren Weaver in *Saturday Review,* Jan. 3, 1959; "The New Supersensory-Superrational Man" by Pitirim A. Sorokin in the popular magazine *Fate,* April, 1959; and "The Revolution in Science" by J. W. N. Sullivan in *Science of Mind* magazine, March, 1959. Bergson's *Matter and Memory* has just been reprinted by Doubleday, and other recent books such as Progoff's *Death and Rebirth of Psychology* and Barrett's *Irrational Man,* while not specifically bringing parapsychology into their discussions, yet perform a useful service by introducing concepts which would be far more congenial to parapsychology than the present intellectual climate.

I might add that the tempestuous wind that is blowing through physics today (a French scientist's picturesque description) has swept away the old-line materialism as far as the top physicists are concerned, even though some of the bottle-washers and button-pushers have yet to hear the news.

The weirdest current lunacy is the cyberneticist view of human personality. By developing a general theory of automata and working out all the equations expressing correspondences between the behavior of neural networks within the human organism and the electrical processes of the computer, the cyberneticists imagine they will be (or already are) in a position to define mind and machine alike as a "patterning of information." This delusion is the old cerebrocentric fallacy in a new form, for the cyberneticist theoreticians fail to understand that expansion of information theory to the *n*th degree will in itself justify them as little in attributing psychic qualities to brain tissue as to transistors and cryotrons. As a matter of fact, the cyberneticist conception of human nature suffers from twin fallacies, one of them of the reductionist variety. On the one hand, the machines are anthropomorphically endowed with life and mind ("memory," "thought," "learning," etc.), pretty much as waterfalls and thunderstorms are animistically conceived by savages; on the other

hand, human beings are mechanicomorphically reduced to biochemical mechanisms responding automatically to internal and external stimuli. The fact is, of course, that all computers must be designed, manufactured, and programmed by human beings and their output must be evaluated by human consciousness, which is to say that their operations have no meaning in themselves. At the same time, human experience can be grasped only on an internal or introspective level of observation—a truth which cyberneticists and behaviorists will understand as soon as they can rid themselves of misinterpretations of operational techniques.

One of the most ludicrous exhibitions of cyberneticist "reasoning" is to be found in A. M. Turing's paper "Can a Machine Think?" which is included in the four-volume *World of Mathematics* published by Simon and Schuster. There is a sort of whining tone throughout his lucubrations, plus an extraordinarily frank prejudice against ESP. He is honest enough to confess that he cannot brush away the statistics, but he speaks of psychic phenomena as "disturbing," wishes he could "discredit them," "unfortunately" finds this impossible, complains about the difficulty of "fitting them in," "fears" that ESP may be peculiarly relevant to thinking, worries that it may lead directly to acceptance of "ghosts and bogies," and suggests "forgetting about it"—since "many scientific theories seem to remain workable in practice in spite of clashing with ESP." In the end, he admits that ignoring parapsychology may be "rather cold comfort" and weepingly remarks that "with ESP *anything* may happen." What is all this but a silly prejudice rooted in the "sectarian science" long ago castigated by William James?

I have gone into some detail on this dreary business because the anthropomorphic terms used in connection with the admittedly important and ingenious computers have a way of misleading the public. It should be realized once for all that certain combinations of metals, plastics, colloids, and electrical processes may indeed constitute a "brain," but that no brain, whether electronic or protoplasmic, is logically synonymous with a mind. General recognition of this fact will in itself be conducive to favorable consideration of parapsychological research.

Yours sincerely,
(Signed) T. Dumont

PARAPSYCHOLOGICAL ABSTRACTS

SARA R. FEATHER

[This section consists of abstracts of reports published in other journals, of unpublished reports filed at the Parapsychology Laboratory at Duke University, and of books which do not appear in our book review section. Readers may obtain unabridged copies (Thermo-Fax) of the unpublished reports by writing to the *Journal of Parapsychology*, College Station, Durham, N. C. The price is ten cents per page.]

FODOR, N. *On the Trail of the Poltergeist.* New York: Citadel Press, 1958. 222 pp.

This is the author's account of his observation and psychoanalytic study of the so-called Poltergeist of Thornton Heath, a group of bizarre occurrences which took place twenty years ago in the home of a Mr. and Mrs. Forbes in a middle-class suburb of London. Dr. Fodor, then Director of Research for the International Institute for Psychical Research (now discontinued) gives a detailed account of the successive phenomena, from cup-throwing and "apports" to "vampire visitations," which surrounded the person of Mrs. Forbes whom he had occasion to observe for over five months. Finally, when he placed her under more controlled conditions at the Institute headquarters, he discovered her in deliberate and clever fraud. In spite of this, however, Fodor maintains that there were genuine phenomena intertwined with the fraudulent, and on this parapsychical thread he goes on to study the possible psychological trauma in her past which might have caused Mrs. Forbes to produce both kinds of phenomena, genuine and fraudulent. In the introduction to his book Dr. Fodor briefly states his side of the considerable controversy stirred up by this approach to psychical research. He includes a letter from Sigmund Freud expressing the latter's interest in this application of psychoanalytic methods, although not committing himself to anything parapsychological.

HEINLEIN, J. H., AND HEINLEIN, C. P. What is the role of ESP in objective testing at the college level? *J. Psychol.*, 1958, 46, 319-28.

There was no evidence of precognition or clairvoyance in two separate investigations in which 20 class groups of college students were asked (1) to predict the order of a true-false test pattern; and then later (2) to guess the order of that same target pattern after it had been mechanically determined by the experimenter. The total results did not differ significantly from chance expectation nor was the statistical spread of scores any more extensive than chance would allow. An examination of the tabulated data, however, indicates that the normal curve of errors does not fit the empirical distribution of scores. Probability figures are not given on this because the authors question the very basis of such calculation. They have doubts about the parapsychologist's use of the standard deviation as an accurate measure of dispersion whenever the empirical distribution is allokurtic or skewed, as here. (To do so is analogous, they say, to the practice in education of converting student achievement grades into standard scores as if they properly belonged to a normal distribution.)

MANGAN, G. L. *A Review of Published Research on the Relationship of Some Personality Variables to ESP Scoring Level.* Parapsychological Monographs, No. 1. New York: Parapsychology Foundation, 1958.

In summarizing the trends suggested by the pertinent ESP-personality data, Mangan notes some progress toward differentiating the personality characteristics of *groups* of high- and low-scoring subjects, although little is known about the personality of the exceptional individual performer. From the results of group testing, he says, "we might judge that subjects who are somewhat extraverted, secure, temperate, well-adjusted, who are favorably disposed towards ESP, and who have a high theoretical value system tend to score high, while subjects who possess opposite characteristics tend to score low." In large part, research in this area has followed two different lines characterized by different instruments for measuring personality and by different degrees in the consistency of the results

obtained. One approach, in which B. Humphrey Nicol has been the main worker, has utilized questionnaire methods of personality assessment and more or less objective ratings of certain qualities exhibited in the subjects' drawings. The general lack of repeatability found with these experiments is probably due to the limitations of the methods, such as their susceptibility to the irrelevant influences of subjects' mood, attitude, etc., as well as to the transitory nature of the personality factors being measured (such as expansion-compression, security-insecurity, and introversion-extraversion). The other main research approach, that of G. R. Schmeidler, has generally used attitude classifications and projective techniques and has brought more consistent results and generally repeatable experiments. However, Mangan points out, we know little about what factors may underlie the "sheep-goat" classification which, in turn, correlates with ESP scoring level. The repeated success of the Rorschach and the Rosenzweig Picture-Frustration Scale in discriminating between high and low scorers may be due to the fact that these techniques apparently give reliable gross estimates of basic and enduring factors of personality structure.

REED, BECKY. A comparison of clairvoyance test results under three different testing conditions. (Unpublished manuscript.)

Fifteen high school subjects who were all A and B students completed five runs for clairvoyance in (1) a quiet room, (2) a room in which Dixieland Jazz was being played, and (3) a room in which soft relaxing music was being played. There were no significant differences in the level of scoring under the three conditions. Combining the critical ratios of each of the five-run sessions completed by the 15 subjects under the three conditions gives a chi-square of 80.59 (45 d.f.) which has a P-value of .0007. The experiment was carried out in Orange, Texas, as a science fair project which took second place honors. The author is at present a Freshman at Southern Methodist University.

THE PARAPSYCHOLOGICAL ASSOCIATION

Second Annual Convention of the Parapsychological Association

The second annual convention of the Parapsychological Association will be held in New York City, September 10 through 12, at the Hotel Martinique located at Broadway and 32nd Street. Registration is scheduled for 9:00 A.M. on September 10, to be followed by the convention call to order at ten o'clock.

Dr. R. H. Thouless, Reader in Educational Psychology at Cambridge University, will deliver an address "Where Do We Go Next in Parapsychology?" at the convention dinner on September 10. Dr. Gertrude R. Schmeidler will give the presidential address on September 11.

Experimental, statistical, and theoretical papers are scheduled for the five sessions of the two and a half day convention period. Members and Associates will receive announcement of the full program prior to the convention date.

All members and Associates requiring hotel accommodations are urged to help minimize the convention costs by staying at the Martinique. Room rates are $7.00 per person for single rooms and $5.00 per person for double rooms. Air-conditioned rooms are an additional dollar on the above rates. Members should make their own reservations by writing to the Hotel Martinique.

The Program Committee consists of Dr. Karlis Osis (80 Glen Ridge Avenue, Glen Ridge, New Jersey), Miss Margaret Anderson, and Dr. David S. Kahn. The convention arrangements are being handled by Mr. Robert Taetzsch (510 Lorraine Avenue, Middlesex, New Jersey). Any inquiries may be directed to either Dr. Osis or to Mr. Taetzsch.

Erratum

In the article "Parapsychology and Time: Comments on Dr. Kooy's Paper 'Space, Time, and Consciousness' " by C. T. K. Chari in Vol. 22, No. 1 (March, 1958), the following correction should be made:

Page 42, second paragraph, tenth line

"before-cone" (*Nachkegel*) and the "after-cone" (*Vorkegel*)

should read

"before-cone" (*Vorkegel*) and the "after-cone" (*Nachkegel*)

GLOSSARY

A description of the basic experimental methods, of the findings, and of the statistical procedures for evaluating ESP and PK results may be found in *Parapsychology, Frontier Science of the Mind* by J. B. Rhine and J. G. Pratt (published by Charles C. Thomas, Springfield, Illinois, U.S.A., Blackwell Scientific Publications, Ltd., Oxford, England, and The Ryerson Press, Toronto, Canada).

AGENT: The "sender" in tests for telepathy, the person whose mental states are to be apprehended by the percipient. In GESP tests, the person who looks at the stimulus object.

BT (Basic Technique): The clairvoyance technique in which each card is laid aside by the experimenter as it is called by the subject. The check-up is made at the end of the run.

CALL: The ESP symbol selected by the subject in trying to identify a target.

CHANCE: The complex of undefined causal factors irrelevant to the purpose at hand.

Chance Expectation = Mean Chance Expectation: The most likely score if only chance variation is present.

Chance Average: Mean chance expectation expressed as an expected score, generally in terms of average per run.

CHI SQUARE: A sum of quantities each of which is a deviation squared divided by an expected value. Also a sum of the squares of CR's.

CLAIRVOYANCE: Extrasensory perception of objective events as distinguished from telepathic cognition of the mental activities of another person.

CR (Critical Ratio): A measure to determine whether or not the observed deviation is significantly greater than the expected random fluctuation about the average. The CR is obtained by dividing the observed deviation by the standard deviation. (The probability of a given CR may be obtained by consulting tables of the probability integral, such as Pearsons.)

CR_d (Critical Ratio of the Difference): The observed difference between the average scores of two samples of data divided by the standard deviation of the difference.

DEVIATION: The amount an observed number of hits or an average score varies from the mean chance expectation or chance average. A deviation may be total (for a series of runs) or average (per run).

DISPLACEMENT: ESP responses to targets other than those for which the calls were intended.

Backward Displacement: ESP responses to targets preceding the intended targets. Displacement to the targets one, two, three, etc. places preceding the intended target are designated as (—1), (—2), (—3), etc.

Forward Displacement: ESP responses to targets coming later than the intended targets. Displacement to the targets one, two, three, etc. places after the intended target are designated as (+1), (+2), (+3), etc.

DT (Down Through): The clairvoyance technique in which the cards are called down through the pack before any are removed or checked.

ESP (Extrasensory Perception): Awareness of or response to an external event or influence not apprehended by sensory means.

ESP CARDS: Cards, each bearing one of the following five symbols: star, circle, square, cross and waves (three parallel wavy lines).

ESP PACK: Twenty-five ESP cards.

Closed Pack: An ESP pack composed of five each of the five symbols.

Open Pack: An ESP pack made up of the ESP symbols selected in random order.

EXPECTATION: See *Chance.*

EXTRACHANCE: Not due to chance alone.

FREE MATERIAL: The stimulus objects of experiments in which an unlimited or unspecified range of stimulus objects is employed (as contrasted with methods such as card-calling in which the subject knows that the stimulus object is one of a known range).

GESP (General Extrasensory Perception): A technique designed to test the occurrence of extrasensory perception, permitting either telepathy or clairvoyance or both to operate.

MCE (Mean Chance Expectation): see *Chance.*

P (Probability): A mathematical estimate of the expected relative frequency of a given event if chance alone were operative.

PARAPSYCHOLOGY: A division of psychology dealing with behavioral or personal effects that are demonstrably nonphysical (that is, which do not fall within the scope of known physical principles).

PERCIPIENT = SUBJECT: The person who makes the calls in an ESP test.

PK (Psychokinesis): The direct influence exerted on a physical system by a subject without any known intermediate physical energy or instrumentation.

PLACEMENT TEST: A PK technique in which the aim of the subject is to try to influence falling objects to come to rest in a designated part of the throwing surface.

PRECOGNITION: Cognition of a future event which could not be known through rational inference.

PREFERENTIAL MATCHING: A method of scoring responses to free material. A judge ranks the stimulus objects (usually pictures in sets of four) with respect to their similarity to, or association with, each response; and/or he ranks the responses with respect to their similarity to, or association with, each stimulus object.

PSI: A general term to identify personal factors or processes which are nonphysical in nature. It approximates the popular use of the word "psychic" and the technical one, "parapsychical."

PSI-MISSING: Exercise of psi ability in a way that avoids the target the subject is attempting to hit.

PSI PHENOMENA: Occurrences which result from the operation of psi. They include the phenomena of both ESP (including precognition) and PK.

PSYCHICAL RESEARCH: Older term used for parapsychology.

QD (Quarter Distribution): The distribution of hits in the record page (or in a logical subdivision thereof, such as the set or the half-set) as found in the four equal quarters formed by dividing the selected unit horizontally and vertically.

RANDOM ORDER: An order of events which displays no trends or regularities that would allow any inference regarding one event from one or more of the others in the series.

RUN: A group of trials, usually the successive calling of a deck of 25 ESP cards or symbols. In PK tests, 24 single die throws regardless of the number of dice thrown at the same time.

SCORE: The number of hits made in any given unit of trials.
Total Score: Total of scores made in a given number of runs.
Average Score: Total score divided by number of runs.

SD (Standard Deviation): Usually the theoretical root mean square of the deviations. It is obtained from the formula $\sqrt{npq}$ in which n is the number of single trials, p the probability of success per trial, and q the probability of failure.

SERIES: Several runs or experimental sessions that are grouped in accordance with a stated principle.

SESSION: A unit of an ESP or PK experiment comprising all the trials of one test occasion.

SET: A subdivision of the record page serving as a scoring unit for a consecutive group of trials, usually for the same target.

SIGNIFICANCE: A numerical result is significant when it equals or surpasses some criterion of degree of chance improbability. The criterion commonly used in parapsychology today is a probability value of .01 or less, or a deviation in either direction such that the CR is 2.58 or greater.

SINGLES TEST: A PK technique in which the aim of the subject is to try to influence dice to fall with a specified face up.

SPONTANEOUS PSI EXPERIENCE: Natural, unplanned occurrence of an event or experience that seems to involve parapsychical ability.

STIMULUS OBJECT: The ESP card or drawing or other object, some identifying characteristic of which is to be apprehended by the percipient.

STM (Screened Touch Matching): An ESP card test in which the subject indicates in each trial (by pointing to one of five key positions) what he thinks the top card is in the inverted pack held by the experimenter behind a screen. The card is then laid opposite that position.

SUBJECT: The person who is experimented upon. In ESP tests, most commonly the percipient (though also the agent in GESP and telepathy). In PK tests, any individual whose task it is to influence the objects thrown.

TARGET: In ESP (including precognition) the objective or mental events the subject is attempting to respond to. In PK tests, the faces of the die which the subject attempts to bring up in the act of throwing. In placement tests, the designated part of the throwing surface.

Target Card: The card which the percipient is attempting to identify or otherwise indicate a knowledge of.

Target Pack: The pack of cards the order of which the subject is attempting to identify.

Target Face: The face on the die which the subject tries to turn up by PK.

TELEPATHY: Extrasensory perception of the mental activities of another person (as distinguished from clairvoyant cognition of objective events).

TRIAL: In ESP tests, a single attempt to identify a stimulus object. In PK tests, a single throw of the dice or other objects thrown.